

Operating and Service Manual



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GOULD

An Electrical/Electronics Company





An Electrical/Electronics Company

MANUAL PART NO.
80-OS36C0

DUAL TRACE OSCILLOSCOPE OS3600

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TABLE OF CONTENTS

SECTION	DESCRIPTION	
1	INTRODUCTION	1.1
2	SPECIFICATION	2.1
3	OPERATING INSTRUCTIONS	3.1
	3.1 Switching On	3.1
	3.2 Obtaining a Trace	3.1
	3.3 Setting of a Y Channel	3.1
	3.4 Dual Channel Operation	3.1
	3.5 Trigger View Operation	3.1
	3.6 A Timebase Operation	3.1
	3.7 A Trigger	3.2
	3.8 Trigger View	3.2
	3.9 Trigger Modes	3.3
	3.10 A Hold-Off	3.3
	3.11 B Timebase and Trigger	3.3
	3.12 Dual Timebase Operation — Normal Delayed Sweep	3.4
	3.13 Dual Timebase Operation — Gated Sweep	3.4
	3.14 Dual Timebase Operation — A and B Alternate Sweeps	3.4
	3.15 X-Y Modes	3.4
	3.16 Additional Facilities	3.4
4	CIRCUIT DESCRIPTION	4.1
	4.1 System Description	4.1
	4.1.1 Y Channels	4.1
	4.1.2 A Timebase Operation	4.1
	4.1.3 Trigger Modes	4.1
	4.1.4 X Expansion	4.1
	4.1.5 B Timebase Operation	4.3
	4.1.6 X-Y Modes	4.3
	4.1.7 Digital Measuring Unit	4.3
	4.2 Y Amplification	4.3
	4.2.1 Attenuators and Pre-Amplifiers	4.3
	4.3 Trigger	4.6
	4.3.1 Trigger Selectors	4.6
	4.3.2 Trigger Amplifiers	4.7
	4.3.3 Trigger Detector	4.8
	4.4 Timebase	4.8
	4.4.1 A Ramp Generator	4.8
	4.4.2 A Hold-Off	4.9
	4.4.3 Auto Single Sweep and X-Y	4.10
	4.4.4 Dual Timebase Operation	4.11
	4.4.5 B Ramp Generator	4.11
	4.4.6 X Mode Selection	4.12
	4.5 X Output Amplifier	4.12
	4.6 Power Supplies	4.13
	4.6.1 Low Voltage Supplies	4.14
	4.6.2 EHT Supplies	4.14
	4.6.3 Tube Controls	4.15
	4.6.4 Bright-Up Amplifier	4.15
	4.6.5 Calibrator	4.16
	4.7 Operation with DM3010	4.16
	4.7.1 Time and 1/Time Measurement	4.17
	4.7.2 Voltage Measurement	4.17

TABLE OF CONTENTS (CONT'D)

5	MAINTENANCE.	5.1
	5.1 General	5.1
	5.2 Access.	5.1
	5.3 Fault Finding Tables	5.4
	5.4 Operating Potentials.	5.10
	5.5 Calibration Procedure.	5.11
	5.6 Calibration Procedure with DM3010 Option.	5.15
6	COMPONENT LIST AND ILLUSTRATIONS.	6.1
7	GUARANTEE AND SERVICE FACILITIES	7.1

FIGURE

LIST OF ILLUSTRATIONS

1	Block Diagram	4.2
2	T/B Waveforms Normal 'A' Sweep	5.17
3	T/B Waveforms Dual Operation	5.18
4	T/B Waveforms DM3010 Time	5.19
5	T/B Waveforms DM3010 Voltage	5.20
6	Trigger Circuit Diagrams	6.6
7	Timebase 'X' O/P & Calibration Circuit Diagram	6.12
8	'Y' Pre-Amp & Beam Switch Circuit Diagram	6.21
9	'Y' Pre-Amp Beam Switch, 'Y' Driver & O/P Circuit Diagram.	6.22
10	Power Supply Circuit Diagram	6.26
11	Interconnections Circuit Diagram	6.29
12	Component Location Top Left View.	6.30
13	Component Location Top Right View.	6.31
14	Component Location Bottom View	6.32
15	Mechanical Assembly	6.34

100MHz represents a major step forward in instrumentation technology for Gould Advance; and the OS3600 is planned to be the forerunner of a comprehensive range of oscilloscopes in the highest reaches of technology.

This dedication to providing oscilloscopes with major user benefits, both for general purpose and more specific applications, automatically results from the resources and in-house requirements of the multi-national Gould Corporation.

The OS3600 and its brother, the 60MHz OS3500 are eminently suitable for the measurement of digital circuits.

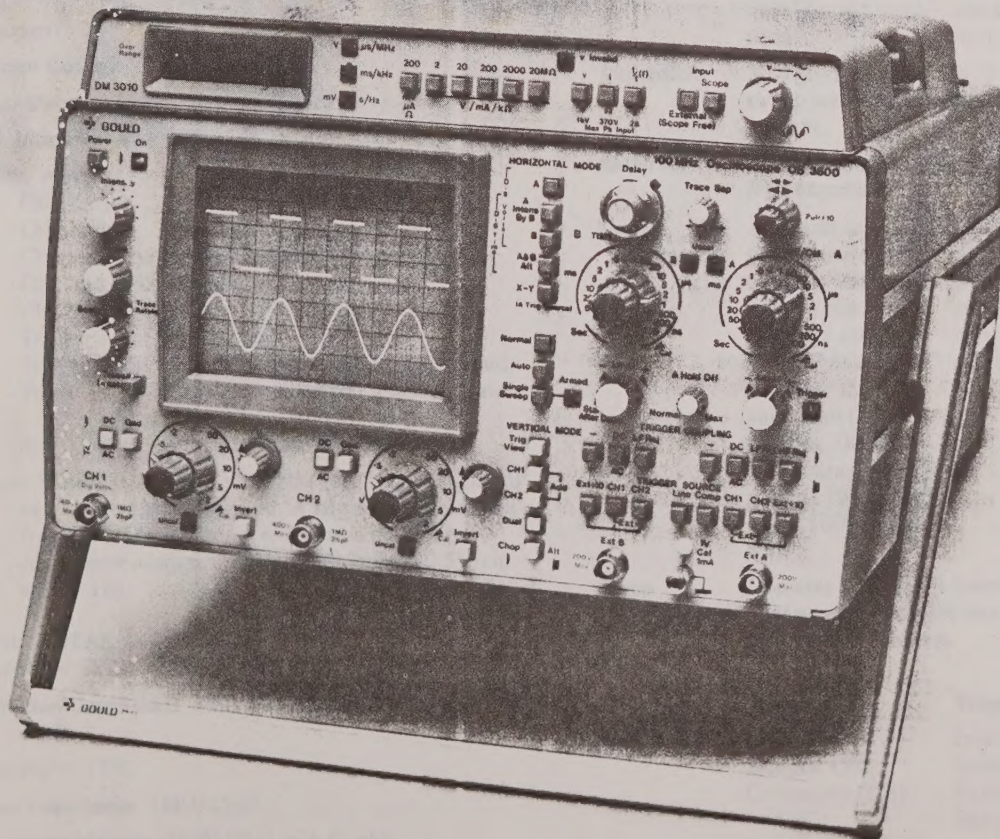
All are portable and ideal for field-service application. The wide range of amplifier and trigger bandwidths covered by these models allows a choice to be made which

is appropriate to the logic family being measured.

Production requirements can be satisfied when using the oscilloscope with their rack-mount adaptors — the logical layout of the front panels making operation simple for the semi-skilled operator. The use of the optional digital measuring unit DM3010 increases reading accuracy and speeds-up measurement time.

The more varied and stringent requirements of the laboratory can also be met from the Gould range. For applications not covered by these powerful models, there is almost certainly another instrument in the range which will "do the job".

In brief, consider Gould if your application is development, production or servicing. For the future!



Specification

Section 2

DISPLAY

CRT 8 x 10cm rectangular.

EHT 16kV overall.

Graticule Internal, with 8 x 10cm divisions and 2mm sub-divisions. Continuously variable illumination.

Phosphor P31 standard, P7 option.

Beam Finder Compresses trace to within graticule area regardless of settings of the vertical and horizontal position controls. Provides pre-set brilliance level.

VERTICAL DEFLECTION

Input Channels Two identical.

Bandwidth D.C.—100MHz (−3dB), d.c. coupled.
2Hz—100MHz (−3dB) a.c. coupled.

Rise Time < 3.5ns.

Input Coupling DC-Ground-AC.

Input Impedance 1MΩ/25pF.

Deflection Coefficient 2mV/cm to 5V/cm in 11 ranges (1-2-5 sequence) with uncalibrated fine gain control giving at least 2.5:1 reduction in gain. Warning light indicates uncalibrated condition.
N.B. Bandwidth at 2mV/cm limited to 85MHz.

Accuracy ±3%.

Position Control Shift range ± 8cm.

Signal Delay Allows triggered edge to be viewed.

Max. Input Voltage 400V (DC plus AC pk).

Display modes

CH1 only.

CH2 only

CH1 and CH2 chopped (500kHz approx.).

CH1 and CH2 alternate.

CH1 and CH2 added.

Trigger View, CH1 or CH2.

Trigger View, CH1 and CH2 alternate or chopped.

Trigger View, alternate or chopped with CH1 and CH2 added.

N.B. Channels 1 and 2 can be inverted.

Trigger View Enables the main timebase trigger signal to be continuously displayed. A trigger signal derived from an external source will have a deflection coefficient of approximately 50mV/cm (0.5V/cm with ÷ 10).

HORIZONTAL AMPLIFIER

Bandwidth D.C. — 2.0MHz (−3dB).

Deflection Coefficient 50mV/cm (500 mV/cm with ÷ 10).

Accuracy ± 15%.

Input Impedance 1MΩ/25pF.

Max. Input Voltage 200V (D.C. + A.C. pk).

X-Y Operation With X input via External Trig. socket
X specification as above. With X input via CH1

or CH2 sensitivity as attenuator setting but accuracy ± 15% (CH1) or ± 5% (CH2).
Phase error < 3° at 500kHz.

HORIZONTAL DEFLECTION

Display Modes Main Timebase.

Main Timebase intensified by Delayed Timebase.
Delayed Timebase.

Main and Delayed Timebase simultaneously
(alternate sweeps).

X-Y with CH1 or CH2 providing X-deflection input.

X-Y₁/Y₂ with line or ext. trig. socket providing
X-deflection input.

	Main Timebase (A)	Delayed Timebase(B)
Sweep Speeds	50ns/cm to 0.5s/cm in 22 steps (1-2-5 sequence)	50ns/cm to 0.5s/cm in 22 steps (1-2-5 sequence)
Fine Sweep Control	Uncalibrated. Reduces sweep rate by at least 2.5 times. (longest sweep approx. 12.5s). Warning light indicates uncalibrated condition.	Uncalibrated. Reduces sweep rate by at least 2.5 times. (longest sweep approx. 12.5s). Warning light indicates uncalibrated condition.
Expansion	X10 gives max. sweep rate of 5ns/cm.	X10 gives max. sweep rate of 5ns/cm.
Accuracy	±3% (±5% with X10 expansion).	±3% (±5% with X10 expansion).
Sweep Delay	A10-turn calibrated vernier control operates with reference to the main timebase setting. Control of delayed timebase start variable from 0.2cm to 10.2cm. Differential Accuracy: ±1.5% rdg. ±0.1% f.s. Jitter: <1 in 10000 of full scale.	The delayed timebase can be started by the main timebase sweep or triggered after a preset sweep display.
Trace Separation	Operates in A and B timebase alternate sweep mode and provides approx. ±4.0cm shift on the B sweep.	
Source	Trigger (A) Internal CH1 Internal CH2 Composite (CH1/CH2) External External ÷ 10 Line	Trigger (B) Internal CH1 Internal CH2 External External ÷ 10

Specification

Section 2

Slope	Pos/Neg.	Pos/Neg.
Coupling	DC DC(hf rej.), AC, AC (lf rej.), AC (hf rej.).	DC, AC, AC (lf rej.)
Modes	Manual level Auto (bright line) Single sweep	Manual level Trigger after delay
Sensitivity	Internal: To 10MHz<2mm (Below 50Hz sensitivity decreases when AC coupled) 10MHz-100MHz <1cm. 100MHz-150MHz 2cm typical External: To 10MHz<10mV (100mV with ÷ 10) (Below 50Hz sensitivity decreases when AC coupled). 10MHz-100MHz < 50mV (<0.5V with ÷ 10). 100MHz-150MHz <100mV (<1V with ÷ 10). Level range (internal): ±8cm. Level range (external): ±0.5V approx. (±5.0V with ÷ 10)	Internal: To 10MHz<2mm (Below 50Hz sensitivity decreases when AC coupled) 10MHz-100MHz <1cm. 100MHz-150MHz 2cm typical External: To 10MHz<10mV (100mV with ÷ 10) (Below 50Hz sensitivity decreases when AC coupled). 10MHz-100MHz < 50mV (<0.5V with ÷ 10). 100MHz-150MHz <100mV (<1V with ÷ 10). Level range (internal): ±8cm. Level range (external): ±0.5V approx. (±5.0V with ÷ 10)
External Trigger	Input impedance, 1MΩ/25pF. Max. input volt 200V (DC plus AC pk).	Input impedance, 1MΩ/25pF. Max input volt 200V (DC plus AC pk).
Trigger Hold-off	Continuously variable up to approx. one sweep length of main timebase, except for three slowest ranges.	

CALIBRATOR

Voltage 1V ± 1%.

Frequency 1kHz approx.

Z MODULATION

Bandwidth DC to 10MHz.

Sensitivity +4V from zero gives complete blanking.

Input Impedance 2.2kΩ.

OUTPUTS

Main Timebase Ramp Output level zero to +4V from source impedance of 10kΩ.

Delayed Timebase Gate Output level +3v to zero from source impedance of 10kΩ.

SUPPLIES

Voltage 100V; 120V; 220V; 240V ± 10%.

Frequency 45–440Hz.

Consumption 80VA.

TEMPERATURE RANGE

Operating 0 to 50°C.

Operating within spec. +15°C to +35°C.

SIZE AND WEIGHT

Size 32.5cm x 18.0cm x 46.5cm (w x h x d) ex. handles and knobs.

Weight 10kg (22lb).

ACCESSORIES SUPPLIED

Handbook Pt. No. 42390

2 off 250MHz probe kits with x 10 attenuation PB14.

OPTIONAL ACCESSORIES

Viewing Hood Pt. No. 42224.

Protective Cover (soft) Pt. No. 42225.

Front Panel Cover (hard) Pt. No. 42226.

Trolleys TR4 or TR6.

Rack Mount Kit Pt. No. 42227.

3.1 SWITCHING ON

CAUTION: The OS3600 is convection cooled and must always be operated in a position such that air circulating through the bottom and side vents is not restricted.

1. Set the support/carrying handle to the required operating position. The handle is released by pulling outward both fixing bushes when it can be turned to lock in any of 5 positions.
2. Before connecting the OS3600 to the supply, check that the supply range switches are set to suit the supply voltage to be used and that the correct fuse is fitted. Note that the fuse has to be changed when switching between the 100V and 220V ranges. The switches and fuse holder are mounted on the back panel of the instrument. Do not operate the range selection switches while the OS3600 is switched on.

SAFETY: The OS3600 is designed to be used with the the frame grounded and it is important that the appropriate lead (Green/Yellow) of the supply, PL98, is connected to a suitable ground.

3. Push the POWER button and ensure that the indicator lamp lights. A trace should be obtained within 1 minute and full calibrated performance within 15 minutes.

3.2 OBTAINING A TRACE

1. To obtain a trace:
 - (a) Select CH1 on VERTICAL MODE switchbank.
 - (b) Select A on HORIZONTAL MODE switchbank.
 - (c) Select AUTO on NORMAL/AUTO/SINGLE sweep switchbank.
 - (d) Operate TRACE LOCATE button, adjust Horizontal shift and CH1 shift to centralize the horizontal trace. These controls are identified by the horizontal and vertical arrows. The inner horizontal shift control should not be pulled out to select X10 expansion.
 - (e) Release TRACE LOCATE and adjust INTENSITY and FOCUS to obtain a sharply defined trace of reasonable intensity.
If the TRACE LOCATE is operated at any time a trace will appear on the screen if the timebase is running. A spot will appear if the timebase is not triggered or X-Y has been selected as the Horizontal Mode.
 - (f) If necessary, adjust TRACE ROTATION for precise alignment of trace with the center graticule.

3.3 SETTING OF A Y CHANNEL

1. Using a coaxial lead (PL43) or suitable probe, connect a signal to CH1 or CH2 input socket and select the corresponding channel on the vertical mode switch bank.

2. (a) For direct coupling of the input signal select DC on the input coupling switch.
(b) For coupling via the internal 0.1μF capacitor select AC.
3. (a) Adjust the VOLTS/cm switch and vertical shift to obtain the required vertical deflection.
(b) The variable control concentric with the VOLTS/cm switch, allows continuous variation of sensitivity between the stepped ranges but when it is turned in an counter-clockwise direction from its CAL position, a red warning light illuminates to show that the deflection sensitivity is no long calibrated.
4. To locate the ground or zero volt level select GND on the input coupling switch. This open circuits the input signal and grounds the amplifier input.
5. If under this GND condition a vertical trace movement is observed on adjustment of the VOLTS/cm switch, reset the STEP BAL preset control for that channel. Access to this is through the bottom cover. This should not be done within 15 minutes of switching on.
6. Deflection which is normally positive-up may be inverted by selecting INVERT.

3.4 DUAL CHANNEL OPERATION

1. Signals applied to CH1 and CH2 inputs can be displayed simultaneously by selecting DUAL on the vertical mode switchbank. CHOP mode of beam-switching should be selected if the sweep speed is slower than about 1ms/cm and ALT (button out) at faster speeds.
2. Signals applied to CH1 and CH2 will be added algebraically onto a single trace when CH1 and CH2 are selected simultaneously. Operation of either INVERT switch will effect subtraction, displaying the difference of the two input signals.

3.5 TRIGGER VIEW OPERATION

Whatever vertical mode has been selected, pushing the TRIG VIEW button on the vertical mode switchbank will bring up another trace showing the signal in the A trigger amplifier. This applies to any trigger source except COMPOSITE, thereby giving three channel operation when the External Trigger source is selected. This facility is covered fully in section 3.8.

3.6 A TIMEBASE OPERATION

The speed of the A timebase is determined by the setting of the A TIME/cm switch. A variable TIME/cm control is fitted concentrically with the A TIME/cm switch which provides a further 3:1 (approx.) variation. When the variable control is turned in a counter-clockwise direction from its switch CAL position a red warning light illuminates to show that the A timebase is no longer calibrated.

The gain of the internal X amplifier may be increased by ten times by pulling out the PULL X10 control on the inner horizontal shift control. This facility is available at all settings of the timebase but not when the X-Y mode is selected. The facility effectively increases the sweep length from 10cm to 100cm and thus allows close examination of any portion of the trace. Any portion of the increased sweep length may be selected for viewing on the display by adjusting the X shift controls (identified by horizontal arrows). The fine shift control will move the display by approximately 1cm when X10 is not selected and by 10cm in the magnified mode. A particular advantage of this facility is to increase the maximum sweep speed to 5ns/cm.

To adjust the time scale of the horizontal axis:

- (a) Set the A TIME/cm switch to the required setting.
- (b) If necessary, adjust the concentric VARIABLE.

3.7 A TRIGGER

The A timebase may be triggered by the following sources as selected from the TRIGGER COUPLING switch.

- (a) CH1 or CH2 selects the output of the appropriate amplifier (irrespective of which beam is displayed).
- (b) COMP (Composite) selects a mixture of CH1 and CH2 signals such that each channel may produce a stable trace (see note at the end of this section).
- (c) LINE: The power supply line input frequency derived internally from the supply transformer.
- (d) EXT: An external triggering source connected to the EXT A socket is selected when CH1 and CH2 are selected simultaneously. The sensitivity of this external input can be reduced 10 times by operation of EXT ÷ 10.

The A LEVEL control allows selection of the triggering point on the trigger waveform and hence determination of the start of the horizontal trace.

The A TRIGGER COUPLING push button switches are used in conjunction with the Trigger Source switches to connect different networks into the trigger amplifier circuit, and are effective for all settings of the Trigger Source switches.

The four switch positions for the A TRIGGER COUPLING are able to latch independently; the functions are detailed as follows:

1. Positive/Negative (marked +/-) determines whether trigger occurs as the input signal passes the selected trigger level in a positive or negative-going direction. This allows the amplifier to trigger on positive-going leading edges when positive is selected (button out) or negative-going leading edges (button pressed in).

2. DC/AC. AC (button out) coupling is useful for wideband trigger on most signals. The DC position is also a wideband trigger mode but is most useful at very low frequencies or when the mark-space ratio of a pulse signal is likely to vary. The Y input coupling must also be set to DC for this mode to be effective on internal trigger.
3. LF REJECT. A filter is switched into circuit to reject low frequencies. This allows stable triggering on the high frequency component of complex waveforms, rejecting low frequency components such as 'hum'. Note that this switch position automatically reverts the trigger amplifier to an ac coupled mode even if dc trigger has been selected.
4. HF REJECT. A dc coupled filter is switched into circuit to reject high frequencies. Low frequency triggering may be effected from complex waveforms containing high frequency components. The cross-over frequency of both the h.f. and the l.f. filters are approximately 10kHz.

NOTE: Since the composite trigger signal is taken after the beam switch, its use is relevant only on dual trace displays in the ALT (alternate CH1 and CH2) mode. Reliable triggering is obtained only with dc trigger coupling when the two traces overlap. In this mode the level control defines a point on the display rather than a level of input signal and the relative position of the trigger point on the waveforms is altered with the Y shift controls.

The main application of this trigger mode is to display two signals of unrelated frequency. Relative phase relationship is lost when displaying signals of the same or related frequency.

Triggering control is effected as follows:

1. Select an A Trigger Source push button for the required trigger signal.
2. Set the timebase to display A sweep.
3. Set the A Trigger coupling for the desired trigger input requirements.
4. Adjust the LEVEL control so that the trace starts at the required point on the waveform. The Trigger View position may be used as a guide to trigger level to assist with this setting procedure (see next section).

3.8 TRIGGER VIEW

This switch is grouped with the Vertical Mode Y channel switches. It may be latched independently and provides an extra trace for viewing the trigger signal as it passes through the A trigger amplifier. The trigger view signal may be viewed together with one or both of the selected Y signals. Display of the trigger view only is not available. Trigger view is not available when Composite trigger is selected.

The Trigger view trace has three main functions.

- (a) It gives a guide to trigger level. The center horizontal line of the graticule corresponds approximately to the dc level of the waveform that the trigger amplifier will select.
- (b) It enables the effectiveness of the LF Rej. and HF Reg. to be observed when filtering is required on a particular signal.
- (c) It enables a third Y channel to be available via the EXT A input socket when the EXT Trigger Source is selected. The trigger view trace must, however, be centered on the screen for the instrument to be triggered in this mode. The A trigger level control operates as a Y shift signal on the trigger view trace.

When viewing signals from CH1 or CH2 the sensitivity of the Trigger view display is approximately that which is selected on the Y channel attenuator switches. The sensitivity to external trigger signal is approximately 50mV/cm (500mV/cm with EXT ÷ 10 selected). Bandwidth of this trace may be only half that of the two Y channels.

3.9 TRIGGER MODES (Normal, Auto and Single Sweep)

These are selected on the 3-way interlocking push button bank mounted above the vertical mode selection switches.

3.9.1 NORMAL

This mode is relevant for all trigger signals from dc to HF. The trace will blank in the absence of trigger signal.

3.9.2 AUTO

When AUTO is selected, the timebase will free-run in the absence of a correct trigger signal to display a bright line or unsynchronised display. When the TRIGGER LEVEL control is adjusted and/or the amplitude of the trigger signal is increased to obtain effective triggering, the timebase will revert automatically to normal operation. This free-run action in the absence of trigger helps in finding the trace and leads to ease of operation.

AUTO is useful for wideband signals above 40Hz. Operation below this frequency may cause mis-triggering since the timebase can revert periodically to its bright-line state.

3.9.3 SINGLE SWEEP

This facility is useful for observing a single event, particularly if a photographic record is required. By pressing the SINGLE SWEEP push button the NORMAL and AUTO buttons will be in the out position and the 'ARMED' i.e.d. indicator will illuminate showing that the timebase is ready to be triggered. On receipt of a trigger signal the timebase will operate and provide one single sweep only. To initiate further sweeps it is necessary to re-arm the timebase by pushing the single sweep button again. The single sweep facility is switched

out when NORMAL or AUTO are selected again. The procedure for operating the timebase to give a single sweep is as follows:

1. Apply a repetitive waveform and obtain a trace with the sweep switch in the NORMAL mode by adjusting the A LEVEL control.
2. Press SINGLE SWEEP button and triggering should then cease. The ARMED indicator should then illuminate in readiness for the trigger signal.
3. The next trigger pulse will initiate a sweep and the i.e.d. indicator will be extinguished on completion of the sweep. The timebase will not operate again until the SINGLE SWEEP button is pressed again.

3.10 A HOLD OFF

When the A HOLD OFF control is in its normal position, switched fully counterclockwise, the hold-off circuit provides sufficient delay for the timebase to recover before the start of the next sweep. When used as a variable control its main function is to provide effective triggering on some complex waveforms. In most positions of the timebase range switch the range of hold-off variation is about equivalent to the time taken for the timebase to complete one sweep. In the case where the timebase is required to be triggered on a complex waveform (e.g. a repetitive logic pulse pattern containing pulses of different widths) then the hold-off may be used to inhibit trigger until the desired period in the waveform is reached.

To trigger on complex waveforms:

1. Adjust the A TIME/cm switch such that the repetition time of the waveform pattern is within the total time of the timebase sweep. Adjust the trigger control in the normal manner until the Trigger indicator lights.
2. Adjust the HOLD-OFF control for a stable trace.

NOTE: When triggering at high frequency, any small jitter which is visible on the trace may be removed by fine adjustment of the HOLD-OFF control.

3.11 B TIMEBASE AND TRIGGER

The speed of the B Timebase is determined by the B TIME/cm switch which, with its uncalibrated variable control, has all the ranges of the A TIME/cm switch. The B TRIGGER SOURCE selection is similar to that for the A channel but does not incorporate LINE or COMP trigger. The B TRIGGER COUPLING is also similar to the A channel but without the HF Reject push button. The B trigger level control operates in a similar manner to the A LEVEL control but incorporates the B STARTS AFTER DELAY switched position at its extreme counterclockwise position.

Note that blue coding is used against all controls relevant to the operation of this second timebase.

3.12 DUAL TIMEBASE OPERATION – NORMAL DELAYED SWEEP

To examine a small period of a stable 'A' sweep:

1. Set the B TIME/cm about two ranges faster in speed than the A TIME/cm switch.
2. Rotate the B LEVEL control fully counter-clockwise to the switched position, B STARTS AFTER DELAY.
3. Set the HORIZONTAL MODE switches to A INTENS BY B.
4. Adjust the INTENSITY control to observe the intensified part of the trace.
5. Adjust the B TIME/cm and the delay multiplier potentiometer so that the intensified portion covers the period of interest.
6. Set the HORIZONTAL MODE switch to the B mode when the intensified section of the previous trace will be expanded to form the full trace. Make final adjustments to the DELAY control and B TIME/cm switch to examine the point of interest as required.

3.13 DUAL TIMEBASE OPERATION – GATED SWEEP

If the display exhibits annoying jitter because of a high degree of expansion or unstable trigger of the A sweep:

1. Return to the A INTENS BY B display mode.
2. Select the appropriate trigger source, slope and coupling on the B push button switches.
3. With the B LEVEL still in the B STARTS AFTER DELAY position, adjust the DELAY control so that the bright-up starts just before the edge of the waveform selected as the B trigger point.
4. Rotate the B LEVEL control clockwise and adjust for a stable trigger by observing the bright-up which will be seen to start at the first B trigger point after the set delay.
5. Select 'B' on the HORIZONTAL MODE switch.

3.14 DUAL TIMEBASE OPERATION – A & B ALTERNATE SWEEPS

This mode provides simultaneous display of the A INTENS BY B and the B traces by switching the beam between the A and B timebase signals on alternate timebase cycles. The traces may be prevented from overlapping by use of the TRACE SEPARATION control which provides up to about ± 4 cm of additional shift to the B trace only. When CH1 and CH2 are displayed in the ALT mode the trace sequence displays two A sweeps (CH1 and CH2) and the two B sweeps (CH1 and CH2).

To display A and B ALT proceed as follows:

1. Set the HORIZONTAL MODE to display A only and obtain a display using only the 'A' timebase controls.
2. Set the B TIME/cm switch two ranges faster in speed than the A TIME/cm switch.

3. Set the B LEVEL to B STARTS AFTER DELAY.
4. Press the A and B ALT switch and adjust the TRACE SEPARATION control to move the traces a reasonable distance apart. Then finally adjust the DELAY control and B TIME/cm for best display.
5. Gated sweep operation as 3.13 can be introduced if required.

3.15 X–Y MODES

Selection of X–Y mode on the HORIZONTAL MODE switch bank disables the timebase and the X deflection is derived from the selection A trigger signal. The X10 X magnification is inoperative in this mode.

1. EXT. X FUNCTION

External X operation is achieved by selection of External Trigger (simultaneous selection of CH1 and CH2) while applying the signal to the EXT. A input socket. The deflection sensitivity will be approximately 15mV/cm (150mV/cm with EXT $\div 10$ selected). AC or dc coupling can be achieved by selection of the relevant TRIGGER COUPLING mode and the HF or LF rejection filters can be introduced if required. This external X deflection can be displayed as a single trace display against the CH1 or CH2 input, their sum or difference as selected by the VERTICAL MODE switches. Alternatively, a dual trace display of both the CH1 and the CH2 inputs against the external X signal by selection of DUAL and CHOP modes. Note that the chop signal at approximately 500kHz may become visible on signals of the smaller orders of frequency. ALTERNATE is not applicable to X–Y display.

2. X–Y FUNCTION

The full flexibility of the two Y input channels can be utilized for a single trace X–Y display by selection of CH2 as the A TRIGGER SOURCE and CH1 as the VERTICAL MODE. It is recommended that DC trigger coupling is selected without use of the LF or HF filters. AC coupling of the X signal is best achieved by the relevant Y channel input coupling switch. In this mode X shift is achieved by horizontal shift control and the relevant (CH2) vertical shift control is inoperative. Note that the X deflection accuracy is impaired if CH1 is selected for X and CH2 for Y.

3. Y LINE FUNCTION

By using the instrument in the X–Y mode and selecting the LINE TRIGGER SOURCE switch, a display of Y versus supply line frequency may be obtained.

3.16 ADDITIONAL FACILITIES

3.16.1 USE OF PASSIVE PROBE

An X10 passive probe may be used to extend the voltage range and increase the input impedance of the Y amplifiers. The input impedance of the instrument is $1\text{M}\Omega$ shunted by 25pF. The effective capacity of the input

lead must be added to this and the resultant impedance will sometimes load the signal source. The probe will reduce this to approximately 10pF and increase the resistance to 10M Ω . To obtain a flat frequency response it is necessary to adjust the probe capacitance to match capacitance of the oscilloscope as follows:

1. Set the VOLTS/cm switch to 20mV/cm, and the A TIME/cm switch to 0.2ms/cm.
2. Connect the probe to the 1V CAL pin.
3. Set the adjustable capacitor in the probe tip or termination, with a small screwdriver, for a square response with no overshoot or undershoot.

3.16.2 1 VOLT CAL OUTPUT

This pin provides a positive-going squarewave of 1V $\pm$ 1% at approximately 1kHz. Shorting this pin to ground will give a square current waveform of 1mA in the shorting link, for current probe calibration.

3.16.3 REAR PANEL OUTPUTS

Two BNC sockets on the rear provide:

1. A ramp, a 4V positive-going sawtooth waveform, from a 10k Ω source impedance.
2. B gate, an approximately +3V level going to ground for the duration of the B sweep.

3.18.4 Z MODULATION

This 4mm socket allows dc coupled blanking to be applied to the c.r.t. The c.r.t. trace is blanked by a positive input. Negative inputs have no effect. The required amplitudes are:

- (a) +1V for visible modulation.
- (b) +4V for blanking at normal intensity.

The input impedance is approximately 2k Ω .

4.1 SYSTEM DESCRIPTION

The block diagram for the instrument is shown in Fig. 1. It is not intended to be a full logic diagram but details the functional points of the circuit and their inter-relation. The circuit can readily be divided into two main sections which are the Y and X deflection circuits, the latter includes the two timebases with their associated trigger systems.

4.1.1 Y CHANNELS

The switched Attenuator, Preamplifier and Trigger Amplifiers are identical for the two Y channels. CH1 differs in having external DVM shift facilities. The state of the decade steps of attenuation and amplifier gain switching are determined by the sensitivity selected. Variable gain and Invert functions are available on each Y channel; these functions being achieved by the use of 'cold' controls applied to a single Y-stage.

The Beam Switch is a fast electronic switch with the equivalent of a change-over action. It sequentially selects the CH1, CH2 or TRIGGER VIEW signals to be passed to subsequent stages. The Beam Switch is controlled by 3 way channel select logic and has the ability to display CH1 or CH2 singly, in pairs or both CH1 and CH2 with Trigger View as a 3 trace display. Trigger View may also be displayed with either Y channel. When DUAL is selected, the channel switch logic may be controlled by the CHOP oscillator in CHOP mode or by the Alternate pulses from the A timebase bistable in the ALT. mode. In the CHOP mode the beam switch is controlled by a free running oscillator switching the beam between the CH1 and CH2 (or Trigger View) signals as the X sweep progresses. In the Alternate mode the channel select logic state is changed at the end of each timebase sweep to give CH1, CH2, (and Trigger View) during successive sweeps.

When Trigger View is selected, the chosen A Trigger signal is conveyed to the Y amplifier as a deflection signal. The center horizontal line marked on the graticule corresponds approximately to the trigger threshold voltage. Hence, the most sensitive trigger position is obtained when the trace is adjusted to this level. Note that Trigger View when selected on its own by the Y-mode switches is also displayed with the CH1 signal.

The signal from the selected channel is passed via a delay line and amplifiers to the Y deflection plates of the c.r.t. This delay allows examination of that point in the waveform which initiated the sweep because the deflecting signal reaches the Y plates after the timebase sweep has been initiated and the trace brightened.

4.1.2 A TIMEBASE OPERATION

The purpose of the timebase system is to generate a linear ramp or ramps to deflect the spot in the X direction. The trigger system initiates each sweep from the incoming or other signals, normally to obtain a stationary display of a repeated waveform. Two timebase systems are included to

allow detailed examination of a chosen section of a waveform. The A Timebase is used for simple sweeps described above and the B Timebase is introduced to provide the expansion when required.

The internal or external signal as selected is amplified by the Trigger Amplifier to drive a trigger circuit. If the timebase is ready to commence a sweep, a transition of the trigger circuit will set the 'A' Timebase bistable which in turn initiates the 'A' ramp. This signal is passed through the Sweep Select switch and X Output Amplifier to the X deflection plates of the c.r.t. At the end of the sweep, when the ramp reaches the required level the bistable is reset, returning the ramp to its original level. During the recovery period the bistable is held reset and this inhibition is maintained by the Hold Off circuit until the ramp generator is fully recovered, ready for the next sweep to commence on the next trigger pulse, when the cycle repeats.

The Bright-Up Amplifier normally holds the c.r.t. beam in the cut-off state. The output of the 'A' Bistable which allows the 'A' ramp to operate, also feeds the Bright Up Amplifier to raise the intensity of the c.r.t. spot to the level determined by the intensity control.

At the end of the sweep, this output of the bistable is reset and blanks the trace during the flyback period.

If the Y channels are being switched in the chopped mode, the output of this multivibrator is also fed to the Bright Up Amplifier to blank the trace while the Y switching transition takes place. This leaves the appearance of two separate traces for CH1 and CH2 on the screen unless the sweep speed is higher than that normally recommended for chop operation.

4.1.3 TRIGGER MODES

The trigger signal for either timebase, selected from either channel internal, external or line frequency sources, is a.c. or d.c. coupled before being fed into the trigger amplifier. This is biased by the required trigger level and the resultant output passed to the trigger circuit to be squared up by the Schmitt trigger.

In the Auto mode, the A Timebase is made to free run in the absence of a trigger signal so giving a bright line reference when, for example, the Y inputs are grounded.

In Single Sweep, the Single Shot bistable normally inhibits its trigger pulses from reaching the 'A' timebase bistable. When the bistable is set manually, the next trigger pulse initiates one sweep and the Single Shot bistable is reset, preventing the timebase from sweeping again.

4.1.4 X EXPANSION

The gain of the X Output Amplifier normally allows the ramp to deflect the spot slightly more than the full 10cm of X scan. The X10 X Expansion increases this gain accordingly giving a full sweep display of greater than 100cm and the X shift control determines which 10cm portion of this appears on the screen. This facility is available on all timebase modes of display, but not on XY.

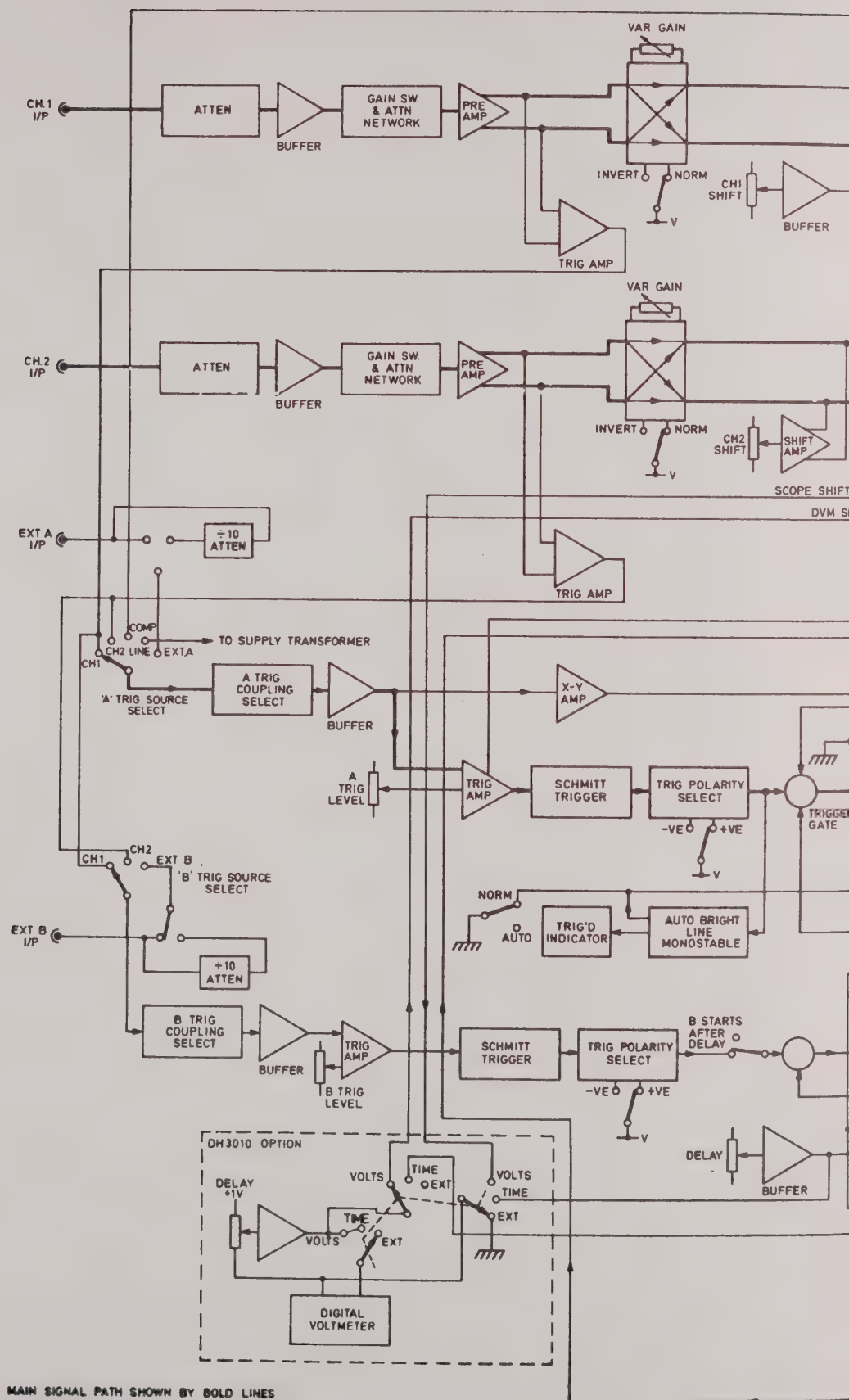
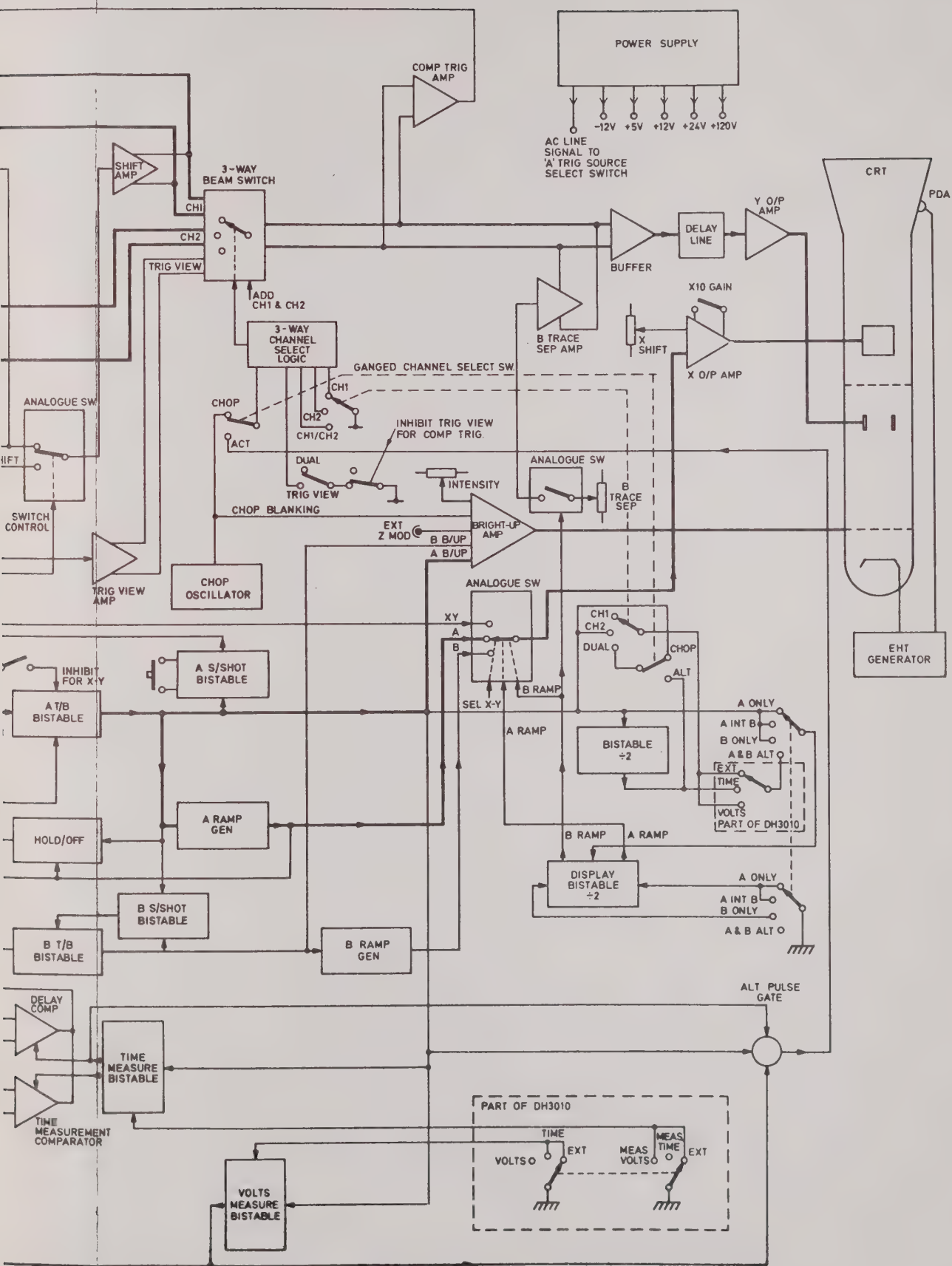


Fig. 1 Block Diagram



4.1.5 B TIMEBASE OPERATION

'A' INTENSIFIED BY B ('B' STARTS AFTER DELAY)

In this mode of operation the 'A' ramp is the same as for 'A' only. The 'B' timebase bistable is switched on at the required point in the 'A' sweep when the 'A' ramp reaches the potential set by the delay control and detected by the Delay Comparator. The 'B' ramp generator then runs either for its full period or until the end of the 'A' ramp, whichever occurs first, when the 'B' bistable is reset. The 'B' single shot bistable ensures that there is only one 'B' sweep during any one 'A' sweep. The output of the 'B' bistable drives the Bright Up Amplifier to brighten the 'B' portion of the 'A' trace above the normal level. This mode is used to identify a portion of the trace for subsequent expansion in the B Only mode.

'A' INTENSIFIED BY 'B' (GATED)

This mode of operation is similar to 'B starts after delay' above, but the B timebase bistable is set only on the receipt of the first B trigger signal after the end of the set delay period, thus synchronising the B sweep to the B trigger signal.

'B' ONLY

In this mode, the 'A' and 'B' timebase systems operate as for 'A Intensified by B' above, but the B sweep is selected by the X Select Switch and the trace is turned on only during the B sweep. The effect on the display is to select and expand the original intensified portion of the 'A' Intensified by 'B' trace to fill the full screen.

'A' AND 'B' ALTERNATE

This mode displays the A ramp and B ramp on alternate sweeps. The first sweep provides an A intensified by B trace, where the A sweep is selected for the X amplifier input, and the B ramp generator provides and intensified trace when the A ramp reaches the position set by the Delay control. On the next A sweep, the B ramp signal is selected to be fed to the X amplifier, and bright up is provided only during the period of B sweep. On this sweep, an additional shift signal controlled by the Trace Separation control is gated into the Y amplifier. This control allows the B trace to be separated from the A intensified trace by up to $\pm 4\text{cms}$.

4.1.6 X-Y MODE

When this mode is selected, the timebase system is inhibited and the Sweep Select switch connects the A Trigger signal to the X Output amplifier as the X deflection signal. Trigger source selection allows the CH1, CH2, External or Line signal to be chosen. Both Y channels may be displayed in X-Y by selecting CHOP mode.

4.1.7 DIGITAL MEASURING UNIT

This optional addition to the OS3600, the DM3010, contains a digital multimeter which can operate independently to measure d.c. voltage, current or resistance. In addition, it can operate with the OS3600 to provide digital readout of parameters displayed on the screen.

VOLTAGE MEASUREMENT

In this mode, the 0V of the DM3010 is connected to the CH1 shift voltage of the OS3600 and an additional shift voltage is generated within the DM3010, determined by the V/T control.

An electronic switch controlled by the Volt Measure Bistable selects as CH1 shift on alternate sweeps, either the normal CH1 shift signal or this additional offset signal. The effect is to produce two traces with an offset which can be set by the V/T control. The DM3010 measures this voltage and scales it according to the CH1 sensitivity chosen, to display the offset directly as a voltage.

TIME MEASUREMENT

In this mode, the 0V of the DM3010 is connected to the delay level set within the dual timebase system of the OS3600. The V/T control determines an offset voltage which is applied to an additional comparator on the A ramp. The output from the normal Delay Comparator or that from the Time Measurement comparator is selected by the Time Measurement Bistable on alternate A sweeps as the signal to initiate the B sweep. The effect is to produce delayed B sweeps at two positions along the A sweep. The time difference between them is indicated as the voltage measured by the DM3010 after automatic scaling according to the Time/cm set on the OS3600.

In the 1/Time or Frequency mode of operation, the measured and reference voltages of the DM3010 are reversed, inverting its reading for it to display the frequency equivalent to the selected time. The control logic inhibits the simultaneous selection of voltage and Time (or Frequency) measurement to avoid a confusing display. A maximum of 6 traces in the absence of time or voltage measurement may be displayed if A and B Alternate is selected, together with CH1, CH2 and Trigger View. The selection of time measurement will then provide the usual extra bright up signals and B sweeps on these six traces corresponding to the levels set up by the DELAY and V/T controls.

4.2 Y AMPLIFICATION

4.2.1 ATTENUATORS AND PRE-AMPLIFIERS

NOTE: The attenuators and pre-amplifiers in the Channel 1 (CH1) circuit are identical to those in Channel 2 (CH2). Accordingly, only CH1 is described. The component numbers in CH1 have an equivalent component in CH2. The odd numbered components off the p.c.b. are in CH1 and even numbered in CH2. On the p.c.b., 100 series numbers are CH1 and 200 series CH2.

The Y input signal is applied via the BNC socket on the front panel and routed to the AC/DC switch S11. In the DC mode, the signal passes, via R49 and C51 in parallel, to the NORMAL/GROUND switch S13, which, when released, passes the signal to the input attenuator selector S9dB. In the AC mode, the DC path via R49 is interrupted by C53.

The input attenuator consists of three fixed networks, giving attenuation ratios of 1, 10 and 100 : 1.

R71, R73, C61, C65 (X10) and R75, R77, C63, C67 (X100) form conventional wideband attenuator networks. C69, C71, C73 adjust the input capacitance on X1, X10 and X100 respectively. The remaining components control the pulse damping of the attenuators. S9dB selects the appropriate attenuator outputs, which is routed via the input protection circuit formed by D102, D104 and zener diodes D101 and D103, to the gate of f.e.t. TR101.

The current required to drive the low impedance section of the attenuator is provided by source follower TR101, and emitter follower TR103. D.C. drift in this section is corrected by a closed-loop circuit including bi-fet op-amp IC101. R79 and R85 tap off 90% of the input signal, which is applied to IC101 and compared with a fraction of the emitter follower output via R178. The error voltage thus produced is used to control the f.e.t. source current, via TR102. Thus, the gate/source voltage of TR101 is adjusted for zero d.c. offset. Pre-set R178 adjusts the fraction of the output fed back to IC101, to equalize the a.c. and d.c. gains of this section. Filter R110 and C103 ensure loop stability. R179 corrects for d.c. offset in IC101, thus acting as an attenuator balance control.

The output from TR103 drives the low impedance section of the gain switching film network R83, which provides the 1-2-5 sequence of gain steps between the X1, X10 and X100 steps of the input attenuator. R836 provides a X10 position which is used on 5V/cm only. The 2mV/cm range uses the 5mV/cm attenuator settings, but the basic amplifier gain is increased by shunting the emitter circuit of dual transistor IC102. The following table shows the complete range switch sequence.

Input Attenuator	Film Network R83			
	g	e/f	d	b
X1	*2mV/5mV	10mV	20mV	
X10	50mV	0.1V	0.2V	
X100	0.5V	1V	2V	5V

*S9df closed

Long-tailed pair IC102 provides the first stage of amplification. R183 allows independent calibration of the 2mV range, and the frequency response on this range is adjusted by A.O.T. capacitor C107.

R180 compensates for any D.C. offset at the emitters of IC102, thus providing d.c. balance for the 2mV range switching.

The next stage is a conventional grounded base amplifier, with R182 correcting the d.c. offset to the following inverting stage. Two differential outputs are taken from TR104 and 105 collectors, one via R87 and 89 to the trigger pre-amplifier, the other via R130 and 131 to the inverting and gain control stage.

IC103 is coupled to form a balanced modulator. The circuit is basically a cascode amplifier, with the upper section split to form an emitter switch. If the voltage at pin 3 is substantially higher than at pin 8, the signal is steered to the collectors at pins 1 and 10. Reversing the voltages at pins 3 and 8 by operating S101 directs the signal to the collectors at pins 2 and 9, which feed the output in opposite phase from pins 1 and 10. With variable gain control R13 in the 'CAL' position the voltage between pins 3 and 8 is sufficient to ensure that virtually all the signal passes in the forward or reverse direction as appropriate. As R13 is turned away from the Cal position, the voltage between pins 3 and 8 is reduced, and the signal from one pair of collectors is partially offset by an inverted signal from the other pair. In this condition, switch S7 on R13 operates i.e.d. D15, to warn the operator that the channel is uncalibrated. Emitter follower TR112 provides a fixed d.c. reference, to maintain the correct mean d.c. level at pins 3 and 8. Pre-set R181, between the emitters of the lower section of IC103, sets the overall calibration of this channel.

Transistor array IC104 provides further amplification and Y shift. Sections c and d form a conventional grounded base stage. A long tailed pair formed by sections a and e convert the shift control voltage at pins 2 and 12 into a differential current signal, which is added to the main Y signal at the emitters of the grounded base stage.

To allow for the optional DVM unit on CH1, the derivation of the shift control voltage differs between the two channels. On CH2 the voltage is simply the attenuated output of shift control R12, while on CH1 it is necessary:-

- To add the shift voltage from the DVM to the manual shift voltage on alternate timebase sweeps.
- To adjust the shift sensitivity at this point to exactly 0.4 volts/cm for DVM calibration.

Pin 12 of IC104 is held at -4.7 volts by zener diode D109. Pin 2 is driven by emitter follower TR106 and the sensitivity at this point is set by pre-set R185. The control voltage from shift pot R111 is buffered by TR107 and sent via PLM pin 5 to the DVM, which adds a measured voltage and returns it via PLM pin 4. An analogue gate, IC106, connects the base of TR106 to the manual shift voltage, via pins 10 and 11, or manual plus DVM shift voltage via pins 8 and 9. The control pins 6 and 12 are operated via TR108 and 109 by signals from the timebase logic, at PLM pins 1 and 3, to give direct and DVM shift on alternate timebase sweeps.

The combined Y signal and shift output at pins 8 and 11 of IC104 passes on to the beam switch, along with the corresponding output from CH2, and an output from the trigger amplifier for trigger view. Each section of the beam switch is based on a transistor array similar to the

ones used for invert and gain control. The lower section of the IC forms a common emitter amplifier with frequency compensating components between emitters. Trimmer C125 serves to equalize the frequency responses of the Y channels. Beam switching is carried out by the upper common base section. If pin 8 of IC107 is at a higher voltage than pin 3, the signal passes via pins 2 and 9 R368, R369, to the common output for the 3 channels. Reversing the control signals on pins 3 and 8 steers the signal to pins 1 and 10, where it is discarded by short-circuiting into the supply rail. This system causes the standing emitter currents, as well as the required signal, to be switched from output to supply line. In all modes except ADD, only one of the three beam switches is active at any instant. However, in ADD mode, CH1 and CH2 are both active, and the common signal rail receives twice as much standing current as in other modes. To compensate for this, when PLM pin 12 goes high to select ADD mode, an emitter switch (section a and b of IC307) causes emitter follower (section d of IC307) to feed extra current into the common signal rail via R390 and 391. The emitter follower output also switches on section c of this IC via R392 and D301. This removes the current which previously passed through D310 to the trigger view beam switch emitters, thus increasing the collector current of this stage to match the combined currents of CH1 and CH2. Thus if ADD and trigger view modes are selected, the current into the common signal rail is constant during beam switching. Trigger view input to the beam switch differs slightly from CH1 and CH2, in the provision of A.O.T. resistor R1369 which adjusts trigger view gain to match the main Y channels, and d.c. offset control R382, which sets the trigger point to centre screen in trigger view.

In all multi-trace modes, the required beam switches are scanned by the beam switch logic at a sufficiently high frequency to give the appearance of a set of steady traces. The mode switches control the beam switch logic via 6 lines of PLM, according to the following truth table.

PLM pin 18 (ALT $\overline{X-Y}$) is primarily the ALTERNATE mode select line. Since the timebase is not running in X-Y mode, ALTERNATE cannot be used, and inter-connections on the push buttons automatically select 'CHOP' mode.

Above lines are directly controlled by the mode switch push buttons. Two further logic lines are decoded by the beam switch logic, and passed via PLM to the timebase logic.

PLM Pin 19 (SINGLE TRACE) High on all single trace modes, i.e. CH1, CH2, or ADD.

PLM Pin 9 (CHANNEL PHASE) Relays the status of the beam switch bistable in ALTERNATE modes.

The beam switch logic is based on a $\div 2$ or $\div 3$ counter formed by IC306 and IC304a, clocked by a multivibrator IC304b and c, in chop mode, or by the end of sweep pulse from the timebase in alternate mode.

In all two trace modes, PLM pin 16 is high, and IC304a holds the $\overline{K1}$ input of IC306 low. $\overline{J1}$ which has no external connection is held low by an internal resistor. With $\overline{J1}$ AND $\overline{K1}$ both low, the first section is in "toggle" mode, i.e. Q1 and $\overline{Q1}$ reverse on each clock cycle. The second stage, which is connected as a shift register, follows these changes one cycle later, thus producing complementary $\div 2$ outputs at Q1 and Q2 (IC306 pins 2 and 15). When 3 traces are required, PLM pin 16 is low, and the inverted feedback from Q2 via IC304a to $\overline{K1}$ produces a $\div 3$ counter with the following phases:-

	$\phi 1$	$\phi 2$	$\phi 3$
Q1	0	1	1
Q2	1	0	1

Q1 and Q1 outputs and the control lines from PLM are decoded by the ECL gates of IC303, IC304, IC305 and drive the beam switches via their complementary outputs. To simplify the decoding of single trace modes, on

LOGICAL FUNCTION OF CONTROL LINE	MODE								
	PLM PIN	CH1	CH2	DUAL	ADD	CH1 & T/V	CH2 & T/V	DUAL & T/V	ADD & T/V
ADD	12	0	0	0	1	0	0	0	1
CH1	13	1	0	0	0	1	0	0	0
CH2 + ADD	14	0	1	0	1	0	0	0	0
3 CHANNELS	16	1	1	1	1	1	1	0	1
T/V	17	1	1	1	1	0	0	0	0

CH2 or ADD modes, the second section of IC306 is held in its reset state via PLM pin 14.

The chop oscillator is formed by IC304b and c, and positive feedback components C310 and R366. This produces, at IC304 pin 3, a square wave output of approximately 1MHz, which is used to clock the beam switch logic, and also via buffer transistor, TR311, to blank the c.r.t. beam during switching. If IC304 pin 10 is held high, the oscillator is stopped, by clamping IC304c low and the output of IC304b is controlled by the alternate pulse from the timebase, via D311 and R359. This will occur:-

- a) When "ALTERNATE" mode is selected. PLM pin 18 is high (unless X-Y mode, which automatically selects "CHOP", is used) and stops the oscillator via D305.
- or b) in any "SINGLE TRACE" mode, D303, 307, 309 and TR307 decode the control lines on PLM pin 13, 14 and 17 to produce a logic 1 level, which stops the oscillator via D308. "SINGLE TRACE MODE" information is also passed to the timebase, via PLM pin 19.

In alternate, multi-trace modes, it is necessary for the state of IC306 Q2 output to be available to the timebase, to allow proper sequencing of the DVM system. TR308 and D306 decode PLM lines 18 and 19 to detect "alternate and not single trace" condition. The Q2 output passing through IC303a is shifted to TTL levels by TR309 and 310 and sent via PLM pin 9 to the timebase.

The combined output from the beam switch system drives a common base amplifier TR318 and 319. A shift signal from the timebase is added at this stage via R345 and 346. This signal is used to separate the traces for A and B timebase sweeps in "A and B alternate" mode.

The next stage is essentially a cascode amplifier, using TR312 and IC302, but a pre-set gain control R367 is included between common emitter and common base sections, to compensate for gain tolerances in the subsequent stages, and limit overdriving of the output module.

IC302 output is adjusted for d.c. offset by R341 and used to drive the delay line L2. R344 provides the correct terminating impedance of 180Ω for the delay line. A second output from IC302 buffered by common emitter stage TR305, 306, provides the Composite Trigger output. R356 allows for d.c. offset in this stage.

NOTE: Interconnection between "COMPOSITE TRIGGER" and "TRIGGER VIEW" push buttons prevent these two functions from being selected simultaneously, which would effectively connect the output of the trigger amplifier to its own input. If this is attempted, "COMPOSITE TRIGGER" is selected, and "TRIGGER VIEW" is suppressed.

R401-404 terminate the delay line to drive common base stage TR401 and TR402. Common emitter stage TR403 and TR404 provides a constant current output to drive the output module. R456 adjusts the common mode current into the output module, to set the mean plate potential on the c.r.t. R-C networks between TR403 and TR404 emitters provide frequency compensation to offset the capacitive load of the c.r.t. The tail current for this stage is normally derived from the -12 volt rail via D404. However, if "TRACE LOCATE" button S400 is operated, this supply is disconnected and a reduced current is provided via R452. This current allows the stage to operate but is not sufficient to drive the trace off screen.

C.R.T. driver IC471 consists of a differential shunt feedback stage with virtual earth inputs to pins 1 and 5, followed by an open collector cascode output stage. To improve the drive capability at high frequencies the shunting effect of collector supply resistors R473 and R474 is relieved by RF chokes L471 and 472. IC471 requires a +7V supply, which is provided by regulator IC472. The output of IC471 passes via stopper resistors R38 and 39 to the Y plates of the c.r.t.

4.3 TRIGGER

4.3.1 TRIGGER SELECTORS

The trigger source for Timebase A is selected by operation of one of the interlocked switches S508, S509, S510, S511 or S512.

The Composite CH1 and CH2 signals are generated at 50Ω impedance on the pre-amplifier board and fed via co-axial cables to S511, S510, S509 respectively. The line signal applied to S512 is derived from a secondary of the supply transformer and fed via pin 601 and a potential divider R665 and R664. C584 removes any unwanted high frequency interference.

The External input signal is fed via a high impedance potential divider with a division ratio of 2.5:1 consisting of R661 and R674 as the series element and R501 (connected across S504) as the parallel element. Input capacitance is set by C589 and frequency compensation by C586 and C588.

C587 acts as a capacitance pad when the EXT. ÷ 10 is selected. The output from this attenuator is conveyed to the Trigger Source switch via pt. 622, R23 and pt. 610 to S508a. When S508 is in the out position and CH1 and CH2 are both selected to give the External function, the signal passes via S508a, S509a, S510a, R578 and R662 to connect to the main trigger amplifier board coupling switches and R501. The sensitivity with S508 in this position is 50mV/cm approx. If, however, S508 is selected, a further ÷ 10 attenuator is inserted in the signal path consisting of R675, R660, C545, C546 and C547 fed via the low impedance network R622 and C548. The EXT. X sensitivity is 500mV/cm for this position of S508.

A selected trigger source, CH1, CH2, Composite, Line or EXT. is then conveyed to the trigger coupling switches via the link from pin 602 on the trigger source board to pin 507 on the main trigger amplifier board,

The switches S501, S502, S503 and S504 all operate independently. The function of the Slope switch, S501, will be described later (Section 4.3.2).

When D.C. only is selected, the signal from pin 507 is routed directly through S503, R599, S502 and S504 to the gate of TR501, the A trigger amplifier. When A.C. coupling is selected by S502, C543 is introduced into the circuit for wideband A.C. coupling. When L.F. Reject is selected by S503, a much smaller capacitor, C542, is introduced, allowing through only the high frequency components of the trigger signal.

When HF Reject is selected, R598 is introduced into the circuit with C514 to ground as a filter to reject high frequency components of the trigger signal.

The B selection and coupling circuitry is similar to that described above for A and is based on S513, S514, S515, S505, S506 and S507. This timebase does not have facilities for Line source, Composite source or A.C. LF rejection coupling.

4.3.2 TRIGGER AMPLIFIERS

The input stage of the amplifier circuit is formed by f.e.t.'s TR501 and TR502. Resistor R501 determines the input impedance of approximately 470k ohms.

Field effect transistors TR501/TR502 are a dual matched pair in a single package. TR501 acts as a source follower and TR502 acts as a constant current load which provides drift correction. R504 and R505 define the source current in each f.e.t., and R506 is an HF stopper.

The f.e.t. stage drives TR503, an emitter follower with two output paths; one from its emitter to the emitter of TR505, via R515 and out to the External X amplifier circuit, the other via R529 to the base of TR507, in the trigger amplifier.

For X-Y operation, the output passes through R515 to the emitter of the common base connected amplifier TR505. The output from the collector of this transistor is applied to emitter follower TR506. Resistors R510, R511 and R512 provide the emitter load, with shunt feedback from the junction of these resistors back to the base of TR505. The circuit gain is this approximately 2 and adjusted by R512. Resistor R514 provides an offset current into the base of TR505, to bias the output voltage at TR506 emitter at 2.0V. Capacitor C506 connected across the base collector junction of TR506 provides a high frequency roll-off to compensate for the delay introduced by the 'Y' Amplifier delay line. The value of this capacitor is determined during initial testing of the oscilloscope. The output from the emitter of TR506 is passed to the X-Y output at PLP pin 10 via R516.

When the X-Y function is not in use, an inhibit signal is applied from socket PLP pin 3. This is in the form of a -12V level applied through R517 to the cathode of D502. This diode is then made to conduct and draws current from R510, R511 and potentiometer R512, thus cutting off TR505 and preventing any output to the X amplifier circuit. With TR505 cut off, the tail current of TR503 will now flow through R515 and R513 in parallel with R507.

To prevent the trigger amplifier TR507/TR508 drawing current from R515 and affecting the X-Y output when X-Y is in operation, an additional inhibit signal of +12V is applied at socket PLP pin 1. This is passed via zener diode D503 and R534 to the emitters of TR507 and TR508, cutting off this stage.

During normal trigger operation, the output from TR503 emitter is applied to the base of TR507. This transistor forms a differential amplifier with TR508. The base bias for TR508 (-0.8V) is provided by the network R524, diode-connected TR504 and R525. This voltage is adjusted by potentiometers R520 and R522, via R521 and R523 respectively. R522 is the main Trigger level control, R520 provides additional bias to balance the amplifier when the A Trig Level control, R522, is central. The gain of the stage is controlled by R528, with frequency compensation provided by R527 and C509, C508.

Outputs from the collectors of TR507 and TR508 are applied to the emitter followers TR511 and TR512 via R548 and R549 respectively. These emitter followers perform the dual purpose of driving the trigger amplifier and the Trigger View signal to the Y amplifier via PLR and the matching resistors R550 and R551. When Trigger View is not required, the signal is prevented from feeding the Y amplifier by the diode gate D516 and D517. The gate is controlled by S713 on the time-base circuit via D514. The normal trigger signal from the emitter followers TR511 and TR512 is fed to the rest of the trigger amplifier via R538 and R539 to the bases of TR509 and TR510. The gain of this stage is determined by the values of R540 and R541 and frequency compensation is provided by C518.

Transistor TR509 feeds the base of TR513 via R558, and TR510 feeds the base of TR514 via R559. This differential amplifier forms the final amplifier stage prior to the Schmitt trigger input.

Circuit gain is determined by the values of emitter resistors R562 and R563, and frequency compensation is provided by R556 and C516. The common tail current flows through R561 and R536 to the -12V rail, and C517 decouples the junction of these resistors at HF.

Transistor TR514 is biased such that its collector is at 3.9V, which is the threshold voltage of an Emitter Coupled Logic (ECL) input signal. A 'high' normally being at 4.4V and a 'low' at 3.4V.

The ECL line receiver package, IC501, is used as the

Schmitt trigger circuit. The signal input is applied to the non-inverting input pin 13 and positive feedback is applied from pin 14 to pin 12 via R569 and C522. R567 is connected to the ECL bias voltage at pin 11 which sits at the logic threshold, (3.9V). The Schmitt sensitivity is determined by the ratio of R567 and R569 and the output signal at pin 14. High frequency performance is improved by the network R557 and C521.

The non-inverted output from pin 15 drives the stage IC501a via its inverting input and IC501b via its non-inverting input. IC501a is used to detect positive trigger slopes and IC501b to detect negative trigger slopes.

When the Trigger Slope switch S501 is set for negative slope, a positive bias is applied to the network R572, R573, R575 and R576, to enable IC501b and cut off IC501c, inverting the trigger output signal. Conversely, for positive slope, this bias is removed, IC501a is enabled, IC501b is cut off and the non-inverted trigger signal is transmitted.

The trigger amplifier of the B timebase is similar to that described above for A, but does not have the XY or trigger view output stages. The input stage is formed by the source follower TR520 and emitter follower TR522. This drives the amplifier TR524, TR525 for comparison against the trigger level defined by R612 with preset R610 for balance. Subsequently, differential amplifier stages TR526, TR527 and TR528; TR529 are used to drive the Schmitt trigger IC502c with slope selection as IC501.

4.3.3 TRIGGER DETECTOR

The buffered output from the A trigger circuit is coupled by C536 into the trigger detector circuit comprising TR515, TR516, TR517 and TR518. The purpose of this circuit is to detect the presence of trigger signals driving the l.e.d. indicator and controlling the timebase in the Auto mode. The square or pulsed waveform from IC501 is differentiated by C536, amplified by TR515 and fed by C533 to a diode detector circuit comprising D508 and D509, with bias provided by D510.

Each resultant negative transition is coupled via D508 into the monostable TR516 and TR517. In the absence of input, both transistors are cut off. A single trigger signal or transition will turn TR516 and TR517 on for a period of approximately 30ms determined by C531, C532 and R587. The output from the emitter of TR517 turns on for a period of approx. 30ms determined by C531, C532 and R587. The output from the emitter of TR517 turns on TR518 to energize the indicator D515. A continual succession of trigger signals above approx. 40Hz will hold the monostable in the on state and the indicator will be energized continuously. The additional output from the collector of TR518 is taken via R595 and FLP pin 3 to the timebase circuit. This is normally near to 0V in the absence of trigger signals but goes low in the presence of trigger signals to inhibit the timebase from free-running.

4.4 TIMEBASE

4.4.1 A RAMP GENERATOR

Each ramp generator is controlled by a bistable which is turned on by a valid trigger or other signal to start a sweep, and turned off at the end of each sweep to await the next start. The bistable for the A timebase is IC701b.

The triggering input, from IC501 on the trigger board, is applied to the Clock input of IC701b at pin 11. If the D input of IC701b is assumed to be high at this time, controlled by IC702c output at pin 15, then the Q output at pin 15 of IC701b will go high and $\bar{Q}$ at pin 14 low on receipt of a positive edge clock pulse.

The Q and $\bar{Q}$ outputs of IC701b feed the bases of transistors TR702 and TR704 connected as a long-tailed differential amplifier. With the Q output high, TR702 conducts and TR704 is turned off.

The principal operation of the ramp generator is the charging of a selected timing capacitor from a constant current source TR714. The linear voltage rise is fed into a buffer amplifier and before a ramp starts, a feedback loop stabilizes this output to ground by drawing off a current via the fly back transistor TR710 which equates the charge current.

In detail, TR702 collector is coupled via R736 to the emitter of the fly-back transistor TR710. When TR702 is turned on, TR710 is cut off and TR702 draws its emitter current from R749. D713 and Zener diode D712 limit the reverse bias on the base emitter junction of TR710. As TR710 is turned off, the constant current source provided by TR714 starts to charge the timing capacitors C721 and C722 with C719 and C720 if selected. Selection of the timing capacitor and resistor value R_T from the resistor network RN is done by the A TIME/CM switch S3. The timing capacitors C719 or C720 are brought into circuit by transistors IC711d and IC711c for the following conditions:- C719 is in circuit when a low timebase velocity range is selected by S3. In this position, S3 provides a positive voltage from the +12V line to the base of IC711d via resistor R753, which saturates IC711d and so connects one end of C719 to ground. In a similar manner, C720 is selected on the mid range timebase velocities, S3 now providing a positive voltage via R754 to the base of IC711c. To ensure that they are cut off when not selected, the bases of IC711d and IC711c are held at approx -4V by R742, R746 and R754, R747 respectively. R758, R759 and D717, D719 are used to 'bootstrap' the output ramp to the collectors of the transistors IC711d and IC711c, ensuring that they do not drop significantly below 0V when the timebase ramp voltage is near zero. Resistor R776 and capacitor C714 at the base of IC711d remove any charge remaining in C719 when switching to a higher velocity range.

The trimmer capacitor C722 allows calibration of the high velocity ranges when neither C719 nor C720 are selected. Note that on the mid ranges when IC711c is on and IC711d is off, C719 remains in series with C720 and their values are chosen accordingly.

The charging current from TR714 is determined by the value of RT, as selected by S3 its emitter voltage with respect to the +24V supply. The base voltage is fed from the emitter follower TR715 as determined by the potential divider network R765, R766, R780, R760 and R769 and potentiometer R767. R767 is used as the main TIME/cm calibration adjustment to set the timing currents accurately for the mid-timebase ranges when the close tolerance capacitor C720 is in circuit. TR713 is normally off but, like IC711d, it is turned on when the low velocity ranges are selected and R761 is effective to allow calibration of these ranges. D716 is reverse biased when these ranges are not selected so that R761 has no effect on calibration.

The variable sweep speed control R7 operates via the components R768, D714, D715 and TR716. In the calibrated position, the wiper of the control connects pin 4 directly to pin 7, and the associated switch S5 is open. TR716 simply acts as an emitter follower defining current in R7 but not presenting an appreciable load to the sweep rate control level at the emitter of TR715. As R7 is turned away from its end stop, S5 closes to energize the UNCAL indicator D12. After a small movement along the track, the voltage between pins 4 and 7 will exceed the necessary drop across D714 and D715 and current will be drawn through R768. Further movement of the Variable control R7 will cause the current in R768 to exceed that in R764. TR715 will be cut off and the control voltage on the base of TR714 will rise under the control of R7, reducing the voltage across RT and hence reducing the charging current to slow the ramp rate as required.

The ramp voltage is monitored at the gate of f.e.t. TR717 acting as a source follower. TR718, in the same package, provides a constant current source for TR717. As the two f.e.t.'s are almost identical and the gate of TR718 is strapped to its source, TR717 is biased automatically for near zero gate-to-source voltage. The ramp output from TR717 is further buffered by emitter followers TR719 and TR720. The output from TR719 is coupled via D719 and applied to the X selector switch IC709b and via R778 to the Ramp Output socket on the rear panel. This signal is also applied via the divider network R729, R711 and R713 to the gate IC702a. When the cathode of D719 reaches approx. +4.4V this gate switches to apply a clear signal to the A timebase bistable IC701b and complete the sweep.

With IC701b reset, TR702 is cut off and TR704 conducts. TR710 conducts as a constant current source to exceed the charging current from TR714 and the ramp voltage returns rapidly toward 0V, i.e. 'flyback' occurs. When the ramp output from TR720 reaches this level, TR723 comes into conduction and its collector current diverts emitter current from TR710. TR722 and TR723 form a comparator and the loop stabilizes the ramp voltage ready to start the next sweep. TR711 conducts only as the ramp reaches its 0V level on fast flyback rates and prevents overshoot of the start point. The

ramp output from TR717 is coupled to emitter followers TR719 and TR720 which are used to buffer the ramp output to the X amplifier and delay comparators IC710a and 710b.

4.4.2 HOLD-OFF

The hold-off circuitry is provided to enable the ramp generator to recover fully at the end of its sweep before another sweep commences. It also allows the 'X' Amplifier to stabilize. The period during which the timebase is prevented from triggering can be varied by operation of the HOLD-OFF control. This allows stable triggering from complex waveforms.

The hold-off system operates in a similar manner to the timebase ramp generator. It contains two constant current sources. TR571 charges one of the hold-off capacitors C710, C712, C713 as selected by the A TIME/cm switch S3. The other constant current source TR721 acts as a flyback transistor to discharge the hold-off capacitors. The voltage on the selected hold-off capacitor turns on TR712 when the potential drops below about 3.6V. The emitter current from the emitter follower TR719 flows through D719 and the potential divider R748 and R770. When the ramp output is rising and reaches about 2V (Approx. ½ ramp period) the potential across the junction of R748 and R770 exceeds the forward potential of D710 and the emitter voltage of TR721, thus turning the flyback source off. This enables the current source TR751 to charge the selected timing capacitor. C712 and C713 are selected by IC711a and IC711b in a similar manner to the timebase capacitors C719 and C720 described previously.

As the hold-off potential goes positive, TR712 is cut off and a logic low is applied to the OR gate IC702c. Positive feedback is applied via R727 and C706 so that a rapid transistion occurs at the output of this gate.

The output of IC702c is applied to the NOR gate IC702d at pin 13. Because the other input of this gate, at pin 12, is the Q output of IC701b, which is high during positive excursions of the timebase ramp, then a logic high is fed from pin 15 of IC702d to the D input of IC701b. The Q output of bistable IC701b therefore remains high, since further clock pulses cannot change its state.

When the ramp has reached its maximum positive (4.4V) level and reset occurs as previously described, the flyback commences. As the flyback continues the ramp output voltage falls and at approximately 2V, diode D710, controlled by the voltage at the junction of R748 and R770 cuts off. This allows TR721 to conduct and discharge the hold-off capacitors via R737.

Variable hold-off is achieved by varying the emitter current of TR721 from the HOLD-OFF control on the trigger p.c.b. via R741. This controls the ramp amplitude seen at the base of TR712 and so varies the hold-off time. Delay periods of up to one timebase period can be achieved.

As a result of the hold off flyback transistor being switched off when the timebase ramp amplitude exceeds 2V, charging of the hold off capacitors C710, C712 and C713 continues until about half of the ramp flyback period has occurred. When the ramp voltage has dropped below 2V the flyback current source conducts again discharging the hold-off capacitors. The discharge period continues well beyond the ramp flyback period until the voltage on the hold-off capacitor has dropped sufficiently to turn on TR712. When the main timebase bistable IC701b switches over driving the Q output low at pin 15 at the commencement of the timebase flyback period, the output of the gate IC702d pin 15 drops low. This puts a low on pin 19 of IC701b, hence further clock pulses do not change the state of the bistable. At the end of the hold off period when TR712 has turned on, the output of IC702d pin 15 is brought high again via the signal from IC702c. This results in a high being applied to pin 10 of IC701b in readiness for the next trigger signal to start another ramp. A negative going signal edge from IC702d pin 9 to capacitor C773 provides positive feedback into the hold off circuit for a rapid switch off.

At the end of each sweep, the emitter of TR703 goes positive and this transistor is coupled through D711, R731 and C763 to produce a positive 'spike' at the input to gate IC707c. This inverts the impulse to generate a narrow low going pulse on its output which is distributed as necessary to switch control circuitry in the various Alternate modes. IC707a is normally enabled except in CHOP mode and drives this pulse to inverting gate IC707b, which provides a negative going edge to the Y-amplifier via Pt. 715 to operate the beam switch.

4.4.3 AUTO, SINGLE SWEEP AND X-Y

The timebase modes, AUTO, NORMAL and SINGLE, sweep are selected by the three interlocking switches, S707, S706 and S708 respectively. Whereas in the NORMAL mode no timebase ramp will occur in the absence of trigger; in the AUTO mode the timebase free runs and produces a bright line trace.

When AUTO function is selected by depressing S707, the ground is removed from the Auto Bright Line input at PLS pin 4. This allows the junction between R720 and C705 to follow the control signal from the trigger detector circuit from PLS pin 4. In absence of trigger, D706 is cut off. D707 and D749 have their anodes taken to the +12V rail via R728 and when IC702c output at pin 14 is low, current will flow from R728 to ground via R724. This causes a logic low to appear on the preset input pin 12 of IC701b via diode D707 and R719.

At the end of the hold-off period, pin 14 of IC702c goes high. The current flowing in R728 will then pull the Preset input of IC701b high via D707. The Q output of IC701b is therefore driven high and the ramp sweep restarts without any trigger applied. When a trigger signal occurs, the trigger detector operates. TR518 on the trigger circuit turns on the 'TRIGGER' i.e.d. and also

removes current from R728 via D706 and R720. This has the effect of making the preset input of IC701b go low. The timebase will only sweep in this condition when a trigger signal clocks the bistable IC701b.

In the NORMAL mode of operation, the ground provided by S707 prevents the Preset input of IC701b from rising, by returning the current in R728 to ground via D706 and R720.

When the SINGLE SWEEP button S708 is depressed, both S706, the NORMAL switch, and S707, the AUTO switch, are released. This inhibits both normal and auto triggering of the timebase. S708 operates as a spring return action switch without any latch action. Each depression of S708 will cause the timebase to be armed in readiness for a trigger signal, which when given will cause the timebase to make one sweep and then reset.

With S708 in the released position, C701 charges via R701 from the +5V rail. On pressing S708, this charge is applied to the Preset input of IC701a at pin 5, setting the outputs to Q high and $\bar{Q}$ low. The Q output at pin 2 of IC701a is applied to the emitter of TR701. Because the base of this transistor is held at approximately 3.3V by the network D702, R710 and R712, it conducts and passes current to the ARMED i.e.d. via R709 and PLV 12. The low $\bar{Q}$ output at IC701a pin 3 is applied via R703 to pin 4 of OR-gate IC702a. The other input to this gate is applied from the reset line to pin 5 which is normally low except at ramp reset, therefore the output at pin 2 will be low to the clear input of IC701b.

IC701b therefore awaits a trigger pulse to initiate a ramp with the single shot ARMED i.e.d. illuminated. When this occurs and the timebase has completed the ramp, IC701b changes its state to Q low (pin 15) and $\bar{Q}$ high (pin 14) in the normal way to commence the fly-back. This action then clocks a logic low to IC701a since the D input is permanently low on pin 7. The Q output at pin 2 of IC701a then drops low and the ARMED i.e.d. is turned off. IC701b is then held reset by IC701a. $\bar{Q}$ signal at pin 3 via the gate IC702a. The bistable IC701a can then be prepared for another sweep by pressing the 'ARM' button S708 once again. R703 and C775 form a low pass filter to prevent narrow spikes from IC701a resetting IC701b if S708 is pressed during a sweep.

When the timebase is in the AUTO or NORMAL modes, IC701a is held preset by diode D701, thus disabling the single shot function.

It is necessary to inhibit the 'A' ramp generator during the X-Y mode of operation. When the X-Y switch S705 is depressed, +12V is applied to the anode of D705 via R716. This voltage is clamped to +5V by D705 and is applied via R714 and D704 to pin 2 of IC702a. This pin is directly coupled to the Clear input of IC701b, the timebase bistable, and holds this circuit in a permanent reset state.

4.4.4 DUAL TIMEBASE OPERATION

In the 'A Intensified by B', 'B' only and 'A & B Alternate' modes, the B timebase is initiated at a selected point during the A timebase sweep as set by the DELAY control. The B timebase may be initiated in two different ways, the simplest mode being B STARTS AFTER DELAY, which is set by S516 on the B TRIGGER LEVEL control, R612. In this mode, the setting on the DELAY control vernier determines directly the start of the B ramp. The B timebase may also be used in the 'B GATED' mode where the B timebase is merely armed on reaching the DELAY setting and awaits a trigger pulse from the B trigger amplifier before a B sweep commences. The delay period is generated as a portion of the A sweep period to the delay comparator circuit.

The A ramp is fed from the emitter of TR720 to the dual comparator IC710a and IC710b, via R897 and R898 to pins 12 and 5 respectively. The bistable IC705b is only functional if Time or 1/Time measurement is required while the DVM option DM3010 is fitted. Normally this bistable is held preset by a shorting plug on PLU pin 6 holding pin 10 of IC705b at 0V. This allows only the comparator IC710b to function since IC710a strobe is held low on pin 9. The DELAY control R5 on the front panel has exactly 4V set across it by the resistors R916, R917 and preset control R915. R917 has only about 80mV across it to act as a back-off voltage for the DELAY control to allow for various offsets in the comparators and timebase ramp generator.

The voltage at the wiper of R5 is fed to the unity gain buffer IC706 at pin 3. The output at pin 6 is then fed to the inverting input of the comparator IC710b at pin 13. When the timebase ramp has risen to the potential set by the DELAY control, the output of IC701b rises quickly to about +3.0V. R887 is used to provide some positive feedback which allows the comparator to snap over cleanly when the desired level is reached. The output from IC701b pin 1 turns off transistor TR746 by diverting the emitter current in R893 to D745 and R895.

The collector of TR746 is only allowed to rise to +4.4V (ECL LOGIC HIGH) by the action of R890. The components D744, D745, C754, C755, R894 and R895 are relevant only when the DM3010 option is used. They introduce a delay of only a few nanoseconds to compensate for any differences in group delay between the two comparators. Section 4.7 covers the operation with DM3010 in full detail.

If the B STARTS AFTER DELAY condition is selected on the B TRIGGER LEVEL control (R612 and S516), then the input on pin 7 of IC703b is low. IC713d is switched off, providing a high input to gates IC703c and IC703d on pins 11 and 12 respectively. Since gate IC703c is turned on, its output at pin 14 will stay low and cannot pass trigger signals from the B Trigger Amplifier. The output of gate IC703d pin 9 goes high, which is applied to the D input of the B timebase bistable, IC704a, at pin 7. The positive signal edge from

the comparator IC710b via TR746 then passes through the two NOR gates IC703a and IC703b to emerge at the IC703b pin 3 and provide a positive edge trigger to clock the bistable IC704a at pin 6. This action initiates the B ramp.

When the B trigger amplifier is to be used in the 'B Gated' mode S516 on the Trigger p.c.b. is closed, applying a high to IC703b pin 7 and at the same time turning on transistor IC713d. This puts a low to the inputs of gates IC703c (pin 11) and IC703d (pin 12). Any trigger pulses from the B Trigger Amplifier will now pass through gate IC703c, becoming inverted as they do so. The output of IC703c pin 14 is fed to the clock input of IC704a pin 6. However, since the D input is low (pin 7) and the bistable IC704a is reset, its state remains unchanged. When the comparator output IC710b rises as the ramp reaches the voltage preset by the DELAY control, the gate IC703d pin 13 is driven high via TR746. This raises the D input of IC704a high and enables the bistable to be clocked upon receipt of a trigger pulse and so start the B ramp generator.

Note that the gate IC703c inverts the trigger pulses and in order for the trigger to have the correct polarity, the +/- TRIGGER SLOPE switch, S505, on the Trigger p.c.b. is wired in a reverse fashion with respect to the A Trigger Amplifier.

4.4.5 B RAMP GENERATOR

The B ramp generation system with its start point stabilization is very similar to that already described for the A Timebase. It does not include Hold-Off or Auto facilities so the circuit description will only be described briefly in this section, unless it is significantly different. When the bistable IC704a changes state to initiate the B ramp, the Q output goes high (pin 2) and $\bar{Q}$ (pin 3) goes low. These two outputs are directly coupled to the bases of transistors TR724 and TR725. TR724 is therefore driven on and TR725 off. TR724 is coupled via R801 to the emitter of the flyback transistor TR727. This allows TR724 to draw the emitter current from TR727, thus turning it off. The constant current charging transistor TR738 then charges the timing capacitors C742, C746, C740 and trimmer C741 as selected by transistors IC713a and IC713b under the control of the B Time/cm switch S4. This switch also selects the current defining resistor RT in the constant current generator TR738, TR739 and TR740.

The potential at the timing capacitors is buffered by the source follower TR736 and emitter follower TR735 to provide the B ramp output.

The ramp output from TR735 is applied to pin 7 of OR-gate IC702 via R793 and HF compensation network R792, C735. These components together with R791 determine the switching point of IC702b and ensure it occurs at the 4.4V maximum excursion of the ramp. When this occurs, the output of IC702b goes high and applies this logic level to the Clear input of IC704a at

pin 4. The Q and $\bar{Q}$ logic levels on this bistable are then reversed, switching the conduction states of TR724 and TR725, causing the ramp to reset.

During the waiting period before the B ramp commences, the output from TR735 is held at 0V by the action of TR733 which acts as a sweep start stabilization control. The emitter of TR733 is connected to 0V via the low value resistor R820. When the emitter of TR735 reaches 0V at the end of the flyback period, some of the current through R825 flows in diode D735 and thus turns on TR733. TR733 then controls the current in the flyback current source, TR727, at its emitter such that the voltage at the emitter of TR735 is maintained at 0V. TR734 in the emitter circuit of TR735 functions as a double diode to compensate for the voltage drops across D735 and the base-emitter of TR733. R824, R821 and C749 prevent overshoot on flyback in a similar manner to R756, R757 and C716 in the A ramp generator circuit.

When the timebase bistable IC704a is reset, the $\bar{Q}$ output at pin 3 goes high. This then clocks the single-shot bistable IC704b at pin 11. The $\bar{Q}$ output of IC704b therefore goes high because the D input at pin 10 is connected to ground. The high at $\bar{Q}$ is fed to the Clear input of IC704a at pin 4 and this prevents further triggering of the 'B' bistable.

When the 'A' ramp has completed its sweep, the 'A' timebase bistable IC701b has a logic high at the $\bar{Q}$ output on pin 14. This high is applied to the Preset input of IC704b at pin 12, reverting the $\bar{Q}$ output at pin 14 to a logic low which is applied to the Clear input of IC704a, enabling this bistable to switch again on the next trigger pulse.

If 'A' only is selected, the 'B' timebase must be inhibited. This is accomplished by applying +5V to the anode of D734 when the 'A' only switch (S701) is depressed. This logic high holds the Clear input of IC704a at pin 4 high and therefore inhibits the 'B' bistable.

4.4.6 X MODE SELECTION

The three way analogue switch IC709 is energised as necessary to select the A ramp signal, the B ramp signal or the X-Y signal to drive the X amplifier. Selection of A or B is derived from the state of bistable IC708a and applied to IC709 via transistors IC712b, IC712c.

When A only is selected by S701, D721 conducts via R852. D722 clamps the Clear input of IC708a to 0V. With Q low and $\bar{Q}$ high, IC712c is turned off and IC712b is turned on. IC709b is energised, selecting the 'A' ramp. Similarly when 'A Intensified by B' is selected by S702, 0V is applied directly to the Clear input of IC708a with the same result.

When 'B' Only is selected by S703, 0V is applied directly to the preset of IC708a. Q is high, $\bar{Q}$ is low. IC712c is turned on and IC712b is turned off, enabling IC709c to select the 'B' ramp.

When 'A and B Alternate' is selected by S704, the Preset and Clear inputs to IC708a are both high and this bistable is clocked at the end of each A sweep by the signal from IC707c. In all single trace Y modes, the preset of IC708b is low and the Q output provides a high input to the J and K inputs of IC708a. The latter then switches state at the end of each A sweep, selecting 'A' and 'B' ramp signals on alternate sweeps.

When a multiple trace mode is selected, e.g. ALT or CHOP, the voltage at PLT 19 drops low and TR748 is turned off, removing the Preset from IC708b. This now forms a $\div 4$ circuit with IC708a and the X selection switches are driven to allow two consecutive 'A' sweeps followed by two consecutive 'B' sweeps. Meanwhile the beam switch in the Y amplifier chain is alternating between CH1 and CH2 to provide the required 4 trace display.

When 'A and B Alternate' is selected, trace separation is required. Operation of S704 removes the bias via R874 holding Transistor IC712a on. This is now switched in parallel with IC712b under the control of IC708a to enable IC709a on each 'B' displayed sweep. The bias set by the TRACE SEPARATION control R4 is applied to IC712c to modify the differential output current from the transistor pair IC712c and IC712d. These signals are fed into the Y signal path.

In the X-Y mode S705 is operated. IC709d is enabled directly to select for X deflection the X-Y signal from the A Trigger Amplifier. Current in R853 via D725 and D726 ensures that both the Preset and Clear signals are applied to IC708a. Q and $\bar{Q}$ are both high, inhibiting both the 'A' and 'B' signals.

4.5 X OUTPUT AMPLIFIER

The ramp input from the timebase via IC709 is applied to the commoned base connections of TR810 and TR812 via R929. These transistors, with TR809 and TR811 form two long-tailed pairs. Transistors TR810/TR809 forming one, TR812/TR811 forming the other.

The opposite commoned base connection of TR811 and TR809 is fed with the X shift voltage from the emitter follower TR815 via R979. The base of the emitter follower is connected to R965 which forms a potential divider with R967 and R966 operated by the COARSE and FINE shift controls. Long-tailed pair TR810/TR809 has a 'tail' circuit comprising R962, R963, R961 and 'Set X1 gain' pre-set potentiometer R960. The 'tail' circuit of TR812/TR811 comprises R959, R958, R956 and 'Set X10' pre-set potentiometer R957. Resistor R928 and C831 across these last two resistors provide HF peaking.

The Long-tailed pair TR812/TR811 have the 'tail' current provided by the constant current source, TR813. The voltage at the base of this transistor is derived from the +24V rail by the potential divider R968 and R970. TR813 emitter is connected to the anodes of

D812 and D813 via R969 and 'adjust on test' component R971 in parallel with it. The cathode of D812 is taken to -12V when S705, the X-Y mode switch, is operated. Similarly, the cathode of D813 is returned to the same potential when the X10 MAGNIFICATION switch is operated. When either diode is taken to -12V the emitter of TR813 can draw current, enabling the long-tailed pair TR812/TR811 and so selecting the X10 amplifier.

A connection is also made from the anodes of D812 and D813 to the base of TR814 which supplies the 'tail' current for the other long-tailed pair TR810/TR809. A negative voltage applied at the base of TR814 will cut this transistor off and the associated long-tailed pair TR810/TR809 will be inhibited. In the absence of the negative bias, TR814 is held in conduction by the potential divider R974, R975 and R976 to the +24V rail. Hence, applying -12V via either D812 or D813 enables the long-tailed pair TR811/TR812 to give X10 X expansion or allowing D812/D813 to float enables TR809/TR810 to give X1 X gain. TR806 and TR808 operate as emitter follower buffers to the common emitter stage TR805 and TR807 respectively. The remaining part of the X amplifier now operates as two independent shunt feedback amplifiers, each driving an X plate. TR803 forms a cascode stage with TR805 as also does TR804 with TR807. The collector loads of TR803 and TR804 are the constant current sources TR801 and TR802. Shunt feedback in the amplifier section TR801, TR803, TR805, TR806 is applied via R938 together with the capacitor 'T' network C814, C818 and trimmer C816 applying HF compensation. This capacitor network operates in a way equivalent to the effect of a very low capacitance variable trimmer across R938. A similar feedback network, R944, C813, C815, C817 exists in the other amplifier half TR802, TR804, TR807 and TR808. The two amplifier halves differ in that TR805/TR806 and TR807/TR808 are PNP/NPN and NPN/PNP respectively. This enables the transistors TR805 and TR807 to provide maximum current drive to the output stages during the ramp period. Accordingly, therefore, the stage TR801/TR803 produces a positive going ramp signal at the commoned collector point, whereas that on the stage TR803/TR804 is negative going. The constant current sources TR801 and TR802 are provided with HF current boost via C807/C808 and C805/C806 respectively. This current drive is provided from TR805 and TR807 and the charge on the capacitors is recovered during the return transient via resistors R930/R941 and R931 respectively.

Components C821, R939, C810, L702 and C820, R943, C811, L701 are used to provide HF stability to each amplifier circuit. The current sources TR801 and TR802 are provided with bias voltage derived from the zener D801 and the bleed resistor R937, with C802 and C822 used for decoupling. This resistor is also used to provide current for the zener D802 which biases TR803. Output to the X plates is fed via R988 and R989 with zener diodes D815

and D816 used to drop the X plate voltage to the mean plate potential.

The commoned emitters of TR805 and TR807 are held at the fixed potential of +7.5V provided by D803, C829 and R946. Hence the voltages at the bases of TR806 and TR808 are also fixed at this value and are virtual earth points. Current drive to these virtual earth points from the common emitter amplifiers TR809 - TR812 described previously is fed via the diodes D806 and D807. Diodes D806-D811 are used in a current limiter circuit to prevent the output transistor TR801 and TR802 from saturating. The operation is best described by considering the case when TR812 is fully on and TR811 fully turned off. This would be the case when the timebase ramp is almost complete and an expanded trace has shifted well off to the right of the c.r.t. screen. TR812 emitter therefore takes all the current provided by the constant current source TR813. The current from the collector which normally flows through D806 to the base of TR806 would be sufficient to turn TR806 off and cause TR801 to saturate. However, because TR811 is not conducting the potential across R955 turns off D807, and the excess current from R955 bleeds through D810 and D811 to the collector of TR810. This prevents TR806 from being turned off and so limits the voltage at the junction of TR801 and TR803 from exceeding 100V. At the same time the voltage at the junction of TR802 and TR804 will be low, and since D807 is turned off, TR804 is prevented from saturating by the action of the current bleed through R951. TR804 normally limits at about +25V. A similar limiter circuit for the other amplifier half exists using D806, D808 and D809 which becomes effective prior to the start of trace on the left hand side of the c.r.t. display.

The TRACE LOCATE is achieved by the circuit R948, R949, D804 and D805. Normally D804 and D805 are reverse biased, with the result that no current flows in R948 and R949. When the TRACE LOCATE button is pressed +12V is applied to D804 and D805. This causes current to flow in R948 and R949 and divert some of the current from flowing in the virtual ground points at the bases of TR806 and TR808. As a result, TR806 and TR808 run out of drive current while the trace is still on the screen and the trace limits prematurely.

4.6 POWER SUPPLIES

The a.c. supply is applied to the primary windings of transformer T1 via the voltage selection switches S15 and S16, fuse FS1 and POWER switch S1. S15 connects the primary windings in series or in parallel, while S16 introduces an additional 20V tap as required. Multiple secondary windings provide low voltage a.c. inputs to the d.c. supply generation circuits. Secondary windings are also provided to supply 6.3V r.m.s. a.c. for the heaters of the c.r.t. and an a.c. input to the Trigger Amplifier circuit for use as described in Section 4.3.1.

4.6.1 LOW VOLTAGE SUPPLIES

+5V D.C. SUPPLY

This supply is derived from the output of bridge rectifier BR1002 supplied from T1. An additional a.c. output is also taken from this winding to supply the 'External DVM' facility (SKQ).

The +9V unregulated output from BR1002 is applied to the voltage regulating integrated circuit IC1003 after smoothing by C1025. The voltage output from the regulator is determined by the ratio of R1049 and R1050. This ratio is such that 5V is obtained at the output. C1026 provides additional smoothing and de-coupling and diode D1023 protects the regulator IC in the event of the +5V output shorting to a negative rail. Fine adjustments of the output voltage of this supply can be made by selection of the Adjust on Test (A.O.T.) resistor, R1058.

-12V D.C. SUPPLY

A further secondary winding of T1 supplies the bridge rectifier formed by D5, D6, D7 and D8. The d.c. output from this bridge is applied to the reservoir capacitor C3 and the voltage regulator IC1002. The ratio of resistances of R1047 to R1048 is adjustable by potentiometer R1052 which is set to give 12V at the output of the regulator. This output is smoothed by C1023 and the positive side is connected to OV. As a result, the un-grounded end of C1023 is therefore at -12V and this point forms the supply rail. Diode D1022 protects IC1002 in the event of the -12V output shorting to a positive supply rail.

The same secondary winding drives D9 and D10 which with D5 and D8 form a further bridge rectifier to generate an unsmoothed full wave rectified supply to drive the graticule illumination lamps. The actual voltage applied to the lamps is controlled by the potentiometer R435 and the emitter follower TR405.

+12V SUPPLY

Diodes D1, D2, D3 and D4 form a bridge rectifier for this circuit. Smoothing is provided by C2 and 18V is thus provided for voltage regulator IC1001. The output voltage is adjusted by R1051 to give +12V. The circuit action is identical to that described for the -12V supply but in this case the negative side of the stabilised supply is grounded.

+60V, +120V AND -120V SUPPLIES

These supplies are derived from a single secondary winding, one end of which feeds a half wave rectifier D1018, giving the 60 volt output, and a voltage doubler circuit, C1021, D1011, D1010, C1019, giving the 120V output. This end of the winding is made to swing $\pm 60V$ about ground by the action of the bridge rectifier and C1017 connected between the low voltage end of the winding and ground. This allows the low voltage end to swing about by $\pm V$ where V is the voltage on C1017. Since the secondary winding supplies current to the 60V and 120V loads, this tends to charge C1017 via BR1001. The voltage across C1017 is adjusted to maintain a constant 60V output by the conduction of

TR1006. When the low voltage end of the secondary winding swings negative, diode (a) in BR1001 is turned on, and the base of TR1006 is at its most negative value (approx -1.5V).

The base of TR1006 is driven by diode D1013 and emitter follower TR1007. This transistor is biased between the +60V and -12V supplies such that its base will be at about 0V when the +60V supply is at the correct voltage. If the +60V supply is high, then the cathode of D1013 will tend to remove excess charge from C1016 on negative transients of the base of TR1006, thus reducing the conduction in TR1006 and allowing the voltage across C1017 to rise. This reduces the swing at the high voltage end of the secondary. If the 60V is low, D1013 will not conduct strongly hence R1042 will force more current into the base of TR1006 to increase conduction and so drop the voltage across C1017, consequently the 60V output will be made to rise. As a result of regulating the +60V supply, the doubled 120V supply will also be partially stabilized. A further -120V supply for the X output amplifier is provided by the doubler circuit C1029, C1030, D1028 and D1029.

+24V SUPPLY

This consists of a 12V regulator IC1004, with its low terminal connected into the +12V rail. Feedback input at the junction of R1031, R1029 is compared with the references (generated internally at pin 4) applied to pin 3. The supply voltage for this regulator is derived from the +75V line by R1027 and the 18V zener D1008 connected to the +12V line. The +24V output from IC1004 at pins 1, 6 and 10 is fed via PLD pin 4 to the timebase circuit. C1006 provides output decoupling and D1012 protects IC1004 against a short circuit to ground by loading down the +12V line.

4.6.2 E.H.T. SUPPLIES

The e.h.t. supplies for the grid, cathode and p.d.a. of the c.r.t. are supplied by a high frequency oscillator or inverter driven from the +12V and -12V supplies. Transformer T1101 is the e.h.t. oscillator transformer driven by transistor TR1103 biased to class C through the feed back winding 4 and 5 at a natural oscillating frequency of approximately 30kHz. Regulation of the -2.2kV supply is provided by a feedback control loop formed by TR1102, TR1101. The amount of drive and thus the magnitude of the e.h.t. output voltage, is determined by the base drive of TR1103 which flows through the feedback winding 4 and 5 of transformer T1101. As point 4 goes positive, increasing the conduction of TR1103, point 5 goes negative and C1105 charges negatively via D1105 and R1112. As a result, the next pulse of output current from TR1103 will be less than the preceeding one and the e.h.t. output will also be smaller unless the charge in C1105 is restored.

The average charge on C1105 is controlled by the collector current of TR1102. If this current is sufficient then C1105 will not discharge, the required current being provided by the transistor. Transistor TR1102 is controlled by an error amplifier formed by TR1101. The reference voltage for this amplifier is derived from the +12V rail via R1105, R1106, R1103 and the error voltage is applied from the 2.2kV output via R1125 to the base of TR1101. The action of the circuit is such that a current balance is achieved at this base.

If the -2.2kV output at the c.r.t. cathode becomes less negative, TR1101 conducts more, increasing the base drive to TR1102 and increasing the current in the output transistor, TR1103, due to C1105 being charged positively. If the -2.2kV output becomes more negative, i.e. the voltage is too high, then TR1101 conduction is reduced. This in turn reduces the drive to TR1102 which allows the charge on C1105 to go negative and thus reduce the output voltage.

Diode D1103 in the emitter of TR1101 is always conducting and provides temperature compensation for this transistor, with the emitter current provided by R1114. Diodes D1101 and D1102 at the base of TR1101 protect the base-emitter junction. Preset resistor R1106 functions as the 'Set e.h.t. control'.

Resistors R1101, R1102 and diode D1104, in conjunction with the choke L1101, form a current limiting circuit. Under normal operating conditions, the current through L1101 is approximately 250 - 300mA. If this should increase beyond this value, the voltage drop across L1101 will cause the decoupled +12V supply at the emitter of TR1102 to reduce to the point where D1104 becomes forward biased by virtue of the voltage across the potential divider R1101 and R1102. This diode then shorts out the error amplifier circuit and breaks the feedback loop so causing an effective current limit.

The secondary of the e.h.t. transformer T1101 drives two separate voltage multiplier circuits. The first circuit is fed from point 8 on the transformer and comprises a voltage doubler formed by C1114, D1111, D1112 and C1115. The resultant output voltage at the junction of R1123 and C1115 is 2.3kV which is smoothed by C1116 after being dropped to 2.2kV by 100V Zener diode D1114. This is the point fed back as the error voltage to TR1101 and is fed via R1120 to the cathode of the c.r.t. holding this at a fixed potential.

R1126 normally holds D1115 on and provides the ground return current for this voltage doubler via the cathode of D1111. This point is decoupled by C1117. If the cathode current drawn by the c.r.t. should become excessive (e.g. at very high Intensity settings) then the return current through D1111 will be greater than that provided by R1126. Hence, TR1105 will be turned on which effectively drives the c.r.t. grid more negative and limits the current in the tube.

An additional voltage doubler circuit C1109, D1107, D1108 and C1111 is driven from the same tap, pin 8, of the transformer but its output is referred at D1107 not to 0V but to the output potential of the bright-up amplifier, driven via emitter follower TR1104. If the emitter of TR1104 is near 0V, the voltage doubled supply, used to drive the grid of the c.r.t. would be at -2.3kV. That is the same as the output from D1112, and so more negative than the cathode by approximately 100V, the voltage across D1114. Thus the c.r.t. will be cut off. The grid is actually fed from R1119, which allows its potential with respect to the cathode to be adjusted to the point of cut off. As the output of Bright-up amplifier, described in Section 4.6.4. goes positive, the grid supply from D1108 will follow and the d.c. level fed to the grid via R1118 and R1039 will rise accordingly. The fast a.c. transition from the blanking amplifier is fed via C1015 and R1021 to the grid. As this electrode moves positively with respect to the cathode the beam of the c.r.t. is turned on. The third output from the e.h.t. oscillator is taken from pin 10 of the high voltage secondary winding and applied to X6 multiplier module to generate +14.3kV which is applied to the p.d.a. mesh of the c.r.t.

4.6.3. TUBE CONTROLS

A potential divider chain R1124, R438 and R433 is connected from the -2.2kV cathode supply to 0V. R438 is the FOCUS control and the wiper of this potentiometer is connected to that electrode. The geometry or I.P.S. electrode is taken to the wiper of a potentiometer, R440, with a control range of +100V to -12V. R447 also provides the 120V HT supply to the astigmatism control R439 which drives A3 of the c.r.t. This electrode potential is settable from +100V to +45V.

The heater of the c.r.t. is supplied directly from its own winding on the supply transformer but its mean d.c. potential is held at the cathode potential by R6.

Minor misalignment of the deflection plates can prevent the trace from aligning with the graticule lines and a correction or trace rotation coil is fitted. Current through this is set by R436 and driven via emitter follower TR406 from the +12V and -12V supply lines. The present of D402 allows the correction current to be adjusted through zero but the connections to the coil must be reversed if a large correction current is required.

4.6.4. BRIGHT-UP AMPLIFIER

The function of the bright-up system is to turn the trace on to the level set by the INTENSITY control during each normal sweep and on continuously in X-Y mode. in the 'A Intensified by B' mode, additional bright-up is applied during B portion of the A sweep. The system is based on a shunt-feedback amplifier and responds to the algebraic sum of signals derived from the INTENSITY control, the A Timebase Bistable, the B Timebase Bistable and external Z mod. input. An

over-riding blanking input can be applied from the Chop Oscillator.

The amplifier is formed by TR1002 and TR1003, with shunt feedback via R1019 from the collector output of TR1003 to the virtual ground at the base of TR1002. TR1005 cascode connected with TR1004 provides a constant current load for TR1003 with additional high frequency drive to the output via C1004.

In the blanked condition D1004 is reverse biased and R1016 and R1018 determine the output level at approximately +5V. Subsequently, current applied via D1004 will drive the output voltage positive. Full bright-up occurs with approximately 2mA in D1004 and the output at approximately +55V. When blanked, the current from the collector of TR1001 is 4mA. 2mA is drawn through R1014 leaving 2mA in D1003. This exceeds any current via R1013 from the INTENSITY control R437.

In the normal 'A' sweep, -2mA is drawn through R1002, reducing the collector current in TR1001 to 2mA. With no current in D1003, the current in D1004 is controlled by R437, i.e. the bright-up is controlled by INTENSITY as set. This condition applies also in the X-Y mode and during the A or B sweeps of 'A and B Alternate' and 'B' only modes.

In the 'A Intensified by B' mode, the current in R1002 is less than 2mA during the A sweep, increasing to 2mA or more during the B sweep. The amount by which this current is less than 2mA is determined by the pre-set Contrast control R850. Thus, the resultant bright-up is determined both by the Contrast and Intensity settings.

In the Chop mode of operation, a positive drive is applied to pin 1014 during each Chop transition. Current through R1011 is applied via D1006 to exceed any current in D1004, blanking the trace as required.

A positive voltage applied to the Ext. Z mod. input will drive current via R1001 and D1001 to provide blanking.

The control currents via R1002 are derived from the timebase circuit as the summed currents from R861, R860, R859 and the collector of TR750.

In 'A' only, with S701 operated, 2mA flows through R851 and D729 into the emitter of TR749. Since the bistable IC708a is in the Cleared state for this mode, TR750 is biased into conduction by the high Q output. The 2mA current from TR749 collector flows through this transistor and balances an equal and opposite current provided by R861. Before the A Timebase commences to sweep, the voltage at the emitter of TR703 is the same as that at the virtual earth blanking input Pt. 708 (i.e. 3V) and no current flows through R860. Also, no current flows through R859 from the B Timebase. As a result, no current drive is applied to Pt. 708. When the A ramp starts the emitter of

TR703 drops to approximately 0V and a -2mA current flows through R860 which enables the Bright-up amplifier.

In the 'B' only mode, with S703 operated, there is no current in TR749 and hence none in TR750. Before the start of the A sweep, R861 defines +2mA into Pt. 708. When the A sweep starts, this is offset by the current in R860 with no resultant bright-up. Only When the B sweep is running also does R859 introduce a further -2mA to cause bright-up.

In the 'A Intensified by B' mode, with S702 operated, R851 and the Contrast control R850 defines a current between approximately 0.7mA and 2mA into the emitter of TR749 and hence through TR750. Thus, during the A sweep the output current is between -0.6mA and -2mA (partial bright-up). When the B ramp is running also R859 introduces a further -2mA for full bright-up.

In the 'A and B Alternate' modes, with S704 selected, D730 energizes the contrast path R850 and R851.

During the A display sweep, the circuit operates as for 'A Intensified by B'. During the B display sweep the Q of IC708a will be low, turning off TR750. The current from TR749 flows through D723 but the output currents are as for 'B' only.

In X-Y, selected by S705, the A and B timebase signals are inhibited and R854 draws 4mA via D728, TR749 and TR750 for a resultant output of -2mA for a steady bright-up.

4.6.5 CALIBRATOR

This circuit provides a readily accessible calibration source for the 'Y' amplifier. Its output is provided at the front panel. The circuit consists of an operational amplifier IC714, connected as a relaxation oscillator with R983 and C844 forming the feedback timing elements. The output voltage swing of IC714 gates a current, derived from the +12V line via R985, into the output resistors R987 and the close tolerance component R699. When the output of IC714 is low, diode D822 is biased on by the positive supply line and current flows into the op-amp output. When the amplifier output is high, D822 is biased off and D821 conducts, passing current into the output calibration resistors. C845 limits the maximum slew rate of the output edges. The output available for calibration purposes is 1.0V or 1mA into a shorting link between the output pin and earth connector.

4.7 OPERATION WITH DM3010

This section covers the control circuitry of the OS3600 which operates specifically with the DM3010. The full circuit description of the DM3010 is included in the handbook for that unit and reference should be made to that also for a full understanding of the complete system.

4.7.1 TIME AND 1/TIME MEASUREMENT

In this mode of operation, the timebase system has to generate B sweeps at two positions on the A sweep. The first occurs at the time set by the normal DELAY control of the OS3600. The second is delayed with respect to the first by a period set by the v/t control of the DM3010. This section should be read in conjunction with Section 4.4.4 and 4.4.5 describing the independent operation of the dual timebase system.

At the end of each A sweep, the emitter of TR703 goes positive and this transition is coupled through D711, R731 and C763 to produce a positive 'spike' at the input to IC707c. This gate inverts the impulse to apply a clock signal to bistable IC705b. This bistable is normally held in the preset state with 0V applied to PLU pin 6. This is applied via a shorting link on PLU if a DM3010 is not fitted and via switch contacts of DM3010 if fitted. When Time or 1/Time modes are selected by DM3010, this link is broken and IC705b is free to switch state at the end of each A ramp. The Q and $\bar{Q}$ outputs thus enable either comparator IC710a or comparator IC710b on alternate A sweeps. IC710a follows the normal DELAY setting while IC710b follows the additional delay level from the DM3010 via PLU pin 5. (See Section 4.1.7).

When the Y display mode 'CH1 and CH2 Alternate' mode is selected, R906 is connected to 0V by S712, and TR747 is free to switch under control of the signal from the beam switch bistable via PLT pin 9. The collector output of TR747 is applied to the J input of IC705b. Both bistables are clocked at the end of the A sweep and this link keeps them in step so that the normal Delayed B sweep is applied to CH1 displaying sweeps and the additionally delayed B sweep to CH2.

When Time Measurement and Trigger View modes are selected together with either CH1, CH2 or ADD, a similar situation exists as would be the case if 'CH1 and CH2 Alternate' were selected. The trace order is locked by TR747 and displays the 1st time delay on Trigger View and the second time delay on either Y channel.

Note that when 'CHOP' is selected for this combination both 1st Delay and 2nd Delay are displayed with each Y channel.

4.7.2 VOLTAGE MEASUREMENT

The generation of the additional Y shift signal which is applied to the CH1 channel when the DM3010 is set to Voltage measurement via the OS3600 is described in Section 4.2. Control of this offset switching is derived from IC705a.

This bistable is normally inhibited from responding to 'end of A sweep' clock signals by a high applied to its

preset input via PLU pin 7. This is maintained by a shorting link when no DM3010 is fitted and via the relevant switch on the DM3010 if fitted. However, when this contact is broken, IC705a is free to respond to its clock inputs and its Q and $\bar{Q}$ output levels reverse state on alternate A sweeps, controlling the Y shift generator of CH1 via PLT pins 1 and 3.

The Q output of this bistable also controls gate IC707a to inhibit every other 'alternate' switching signal to the Y channel beam switch. Thus, when 'CH1 and CH2 Alternate' mode of Y display and DM3010 voltage measurement are selected, the sweep sequence will be CH1, CH2/normal shift, CH1/additional shift, presenting a 3 trace display.

The simultaneous application of 'A and B Alternate' timebase mode with DM3010 voltage measurement is inhibited. Warning of this prohibited combination is given as the relevant l.e.d. on the DM3010 is energized from the -12V supply via S704 and R911. This same signal line applies preset to IC705a to inhibit the voltage measurement sequence. A similar inhibit is applied to IC705a via S705, R841 and D754 when X-Y display mode is selected and voltage measurement does not apply.

When CH1, CH2 and Trigger View are in Alternate trace mode, the Y beam switch IC306a and IC306b divides by 3. The 'J' line to pin 11 of IC705b is then driven high when CH1 and Trigger View are selected, thus the 1st Time Delay is displayed on these channels and the 2nd Time Delay on CH2.

The trace order is as follows:—

CH1/1st Time Delay
Trig View/1st Time Delay
CH2/2nd Time Delay

If 'CHOP' mode is selected, TR747 is not switched into circuit with the result that both Time Delay positions are shown for each Y Channel and Trigger View.

When 'A & B Alternate' is selected for any single trace Y mode without Time measurement selected, transistor TR748 is turned on by the single trace detect signal from PLT 19. However, the selection of Time Measurement reverse biases the emitter of TR748 and this allows the IC708a and IC708b combination to divide by four. The sweep order is thus — A, A, B, B, A, A, B, B etc. It should be noted that the display selection bistables IC708a and IC708b and the Y beam switch bistables IC306a and IC306b are not synchronised, but display all the required traces by virtue of different division ratios which exist between them. The most complex mode is when 'CH1', 'CH2', 'TRIGGER VIEW' and 'A & B ALT' are selected. Twelve A sweeps are required to complete the cycle, and each trace combination is displayed twice within the cycle. The trace order is shown in the following table:—

No. of A Sweeps	Y Mode	Sweep Selected	Delay Selected (1st or 2nd = D1 or D2)
1	CH1	A	D1
2	TV	A	D1
3	CH2	B	D2
4	CH1	B	D1
5	TV	A	D1
6	CH2	A	D2
7	CH1	B	D1
8	TV	B	D1
9	CH2	A	D2
10	CH1	A	D1
11	TV	B	D1
12	CH2	B	D2

5.1 GENERAL

The instrument is protected electrically by 2 fuses:

1. FS1, mounted in a holder on the rear panel, is in the line of the incoming supply. This is a 20 x 5mm slow blow type. 500mA rating (part number 33685) is required for the 220/240V ranges or 1A rating (part number 34790) for the 100/120V ranges.
2. FS1001, mounted on the track side of the power supply p.c.b. behind the moulded plastic cover on the rear panel is a 20 x 5mm slow blow type, 500mA rating (part number 33685). **BEWARE — HIGH VOLTAGES ARE PRESENT ON THIS P.C.B.**

The following sections give information on obtaining access to all internal controls and removal of the various printed circuit boards and assemblies as may be found necessary during servicing.

If, during servicing, a component needs replacing, it is recommended that it is carefully desoldered, using either a vacuum desoldering pump or desolder braid, taking care not to damage either the delicate copper track of the printed circuit boards or adjacent components. It will often assist removal of the leads if the component is first cut away leaving as much of the leads as possible connected to the p.c.b. The practice of attempting to solder a new component onto the remaining leads of the old one is not recommended as it is likely to cause poor mechanical and electrical joints.

If a fault cannot be cleared it is recommended that the instrument is returned to the manufacturer for repair. When faults have been cleared, it is advisable for at least those parts that have been repaired to be recalibrated to ensure that the instrument conforms to specification. Note that all knobs are collet fixing. They are removed by prising out the central cap slackening the fixing screw or nut and withdrawing the knob from the shaft.

5.2 ACCESS

Immediate access is available to nearly all preset controls once the top and bottom covers have been removed.

Figures 13, 14 and 15 illustrate various views of the instrument showing the position and function of the preset controls and the major sub-assemblies of the instrument. Each cover is retained in position by four latch fasteners. Each fastener is released by turning it a quarter of a turn counterclockwise. In the locked position the arrow head on the fastener points towards the adjacent frame.

WARNING: the instrument should be disconnected from the supply while the covers are being removed. Dangerous high voltages are then accessible and the instrument should be operated only by qualified personnel.

The following description details the method for removing the individual assemblies.

5.2.1 Y PREAMPLIFIER AND PREAMP TRIGGER ASSEMBLY

1. Remove the knobs from the Y attenuator switches and Y shift controls.
2. Remove the two nuts holding the attenuator switches to the front panel.
3. Unclip the delay line cable from its fixings around the tube shield and check the cable routing to ensure there is sufficient slack available to withdraw the preamplifier.

WARNING: Do not stress the delay line terminations as the wire is very fragile. If a DM3010 option is fitted, it will be necessary to at least partially remove it (see Section 5.2 of the DM3010 Handbook).

4. Remove the 2 screws and wavy washers, fixing the preamplifier to the pillars screwed to the L.H. sidebar, slacken the screw fixing the front pillar to the sidebar and move the pillar rearwards. Remove the three screws and wavy washers securing the preamplifier to the small blocks screwed to the timebase board.
5. Unplug the multiway connector from PLM at the timebase end (SKT). Unplug the Trigger View input lead (SKN) and the "UNCAL" i.e.d.'s (SKNN and SKPP). Unclip the socket (SKLL) at the end of the cable from the CH1 attenuator switch from its parking clip adjacent to the c.r.t. side contact pins or from PLA on the DM3010 option (if fitted).
6. Carefully withdraw the preamplifier outwards and backwards (taking care not to foul the assembly on any fixings or to strain the delay line terminations) as far as the delay line and coaxial leads will allow.
7. To remove the preamplifier completely carefully unsolder the delay line terminations and mark the connections to assist replacement. Ease the line out of the p.c.b. Unsolder and remove the coaxial cables, again mark them to assist replacement. Remove the preamplifier assembly.

5.2.2 Y OUTPUT DRIVER ASSEMBLY

1. Remove the DM3010 option if fitted (see DM3010 Handbook, Section 5.2).
2. Remove the knobs from the INTENSITY FOCUS AND SCALE controls.
3. Remove sockets SKG, SKH, SKJ, SKK and SKL from the plugs on the p.c.b. Note that SKK is reversible so its position should be marked to facilitate reassembly.
4. Unsolder the red and orange wires from pins 408 and 410 and unplug the pink wire from the c.r.t.
5. Desolder the ground braid from the c.r.t. shield to the Y driver p.c.b. It is important that all ground connections are made in the same places on reassembly.

6. Unsolder the two 10Ω resistors, R36 and R37, from pins 405 and 409.
7. Unclip the delay line from the top of the c.r.t. shield and maneuver it carefully to enable the p.c.b. to be withdrawn. If the p.c.b. has to be removed completely, carefully unsolder the delay line terminations and ease the delay line out of the p.c.b. Mark the terminations to assist replacement.

WARNING: Do not stress the delay line terminations as the wire is very fragile.

8. Remove the L.H. sidebar trim by inserting a screwdriver in the slot near the front panel and carefully prying the trim away from the sidebar. Remove the screw and wavy washer under the trim securing the p.c.b. fixing stud.

9. Remove the remaining 3 screws and washers securing the p.c.b. and carefully withdraw the assembly.

WARNING: Do not operate the instrument with SKK removed. The center conductor is used to ground the external conducting coating of the c.r.t.

5.2.3 Y OUTPUT MODULE P.C.B. ASSEMBLY

1. Unsolder the red and orange wires at the Y driver p.c.b. end from the pins 408 and 410.
2. Unsolder the 2 10Ω resistors, R36 and R37, at the Y driver p.c.b. end from pins 405 and 407.
3. Disconnect the Y output stopper resistors R38 and R39 from the c.r.t.
4. Remove the screw and washer securing the bracket from the output module p.c.b. to the driver p.c.b.
5. Carefully pry out the rear left hand sidebar trim and remove the two screws securing the output assembly to the sidebar. Carefully ease out the assembly. To remove the output module IC471, first desolder the 7 pins and then remove the 2 screws securing the IC to the heatsink. Note that heatsink compound must be used between mating surfaces.

5.2.4 TRIGGER UNIT

1. Remove the knobs from the A Level, B Level and A Hold Off controls.
2. Unsolder the 27Ω resistors, R23 and R24, from pins 610 and 612.
3. Remove the screw and washer securing the small screen to the rear L.H. corner of the trigger source p.c.b.
4. Remove the two screws and washers securing the trigger amplifier p.c.b. to the connecting pillars mounted on the timebase p.c.b.
5. Remove the two screws securing the fixing brackets to the RH sidebar (Note that the captive nuts

will slide along the channel and will need to be re-positioned on re-assembly).

6. Remove the sockets SKP and SKR and unscrew the "p" clip from the timebase p.c.b. which retains the coaxial cables.
7. Slide the assembly rearwards to clear the potentiometer shafts and switch buttons. Tilt the front of the assembly downwards and withdraw to the extent allowed by the coaxial leads. To remove the unit completely, unsolder and remove all the coaxial leads, noting their positions for re-assembly.

WARNING: The push button switches are easily damaged by a hot soldering iron. Take great care not to overheat any of the switch pins and resolder to the top of the pin not down at the switch body.

5.2.5 EXTERNAL X ATTENUATOR P.C.B. ASSEMBLY

1. Unsolder coaxial lead and R15 ($1.1k\Omega$) from the 1V Cal pin. Remove the coaxial lead screen from its fixing ring.
2. Unsolder the 22Ω resistors, R25 and R26, from the Ext. A and Ext. B input sockets.
3. Unsolder the 27Ω resistors, R23 and R24, from pins 610 and 612 on the trigger source p.c.b.
4. Remove the two screws (with washer and solder tag with R15 attached) securing the p.c.b.
5. Withdraw the p.c.b.

5.2.6 TIMEBASE UNIT

1. Remove the d.v.m. option if fitted.
2. Remove the trigger assembly as in 5.2.5 above.
3. Unsolder the following 5 coaxial leads: The 1V cal signal lead from pins 712, 711; the A ramp output lead from pins 719, 720; the B gate output lead from pins 717, 718; the bright-up lead from pins 708, 707 and the alternate pulse lead from pins 715, 716. Mark to ease replacement.
4. Unplug SKT, SKW, SKV and SKX.
5. Unscrew the solder tag from the chassis to the rear of p.c.b. near the X plate leads.
6. Remove the two X output connectors from the c.r.t. Note that the yellow lead goes to the nearest of the two c.r.t. pins to the p.c.b.
7. Remove the 3 remaining screws (with 3 washers and one p clip) securing the top of the p.c.b. to the support rail.
8. Slide the p.c.b. rearwards to clear the push button switches, downwards at the rear end and then out through the bottom of the instrument, taking care not to catch the X output transistors on the transformer.

5.2.7 E.H.T. P.C.B. ASSEMBLY

WARNING: Beware high voltages.

1. Remove the top screen of the unit by unscrewing the three retaining screws.
2. To prevent e.h.t. flashover to the Y preamplifier, place a suitable piece of insulating material between the rear of the preamplifier p.c.b. and the e.h.t. assembly.
3. Remove the e.h.t. socket from the voltage multiplier, MPR1, with a pair of *well insulated* pliers and earth the c.r.t. final anode lead to chassis via a high voltage resistor of 1–50M Ω . Do not short the final anode directly to chassis. Do ensure that SKK is securely in place before discharging the final anode (Pin 2 of SKK is the ground connection for the external conducting coating of the c.r.t.). When the final anode has been discharged connect it to pin 2 of SKK to prevent it recharging due to energy stored within the glass of the c.r.t.
4. Discharge the h.v. output of MPR1 to chassis via a h.v. resistor of 1–50M Ω . Do not short directly to chassis.
5. Remove SKE from the e.h.t. p.c.b.
6. Unsolder the c.r.t. final anode screen and multiplier ground lead from pin 1101 and the multiplier input lead from pin 1102. Remove four screws and washers and lift out the e.h.t. p.c.b. assembly.

5.2.8 POWER SUPPLY ASSEMBLY

Access to the rear of the power supply p.c.b. is obtained by removing the brown plastic moulding at the rear of the instrument which is held by four screws and washers.

WARNING: High Voltages are present on this p.c.b.

The main power supply is a removable assembly forming the rear of the instrument. Removal of the power supply p.c.b. is most easily accomplished after removing the complete assembly from the instrument.

1. Unsolder the coaxial leads from the A RAMP and B GATE BNC sockets on the rear panel, the 0.5V a.c. trigger winding on the supply transformer, pins 1013/1015 and 1014/1016 on the p.c.b. Mark to assist replacement.
2. Remove sockets SKA, SKB, SKC and SKD from the p.c.b. and the c.r.t. base SKA.
3. Pull the actuating rod off the POWER ON switch and withdraw it rearwards through the front panel. Take care not to damage the switch when the rear panel assembly is removed as it is then in a vulnerable position.
4. Remove the four screws and washers from the inside rear of the instrument which are nearest the corners, releasing the rear mounting feet.

5. Remove the four screws and washers securing the brown plastic moulding covering the rear of the p.c.b.
6. Remove the four countersunk screws fixing the rear panel to the side frames and the two countersunk screws securing the top bar. Withdraw the unit.

5.2.9 CATHODE RAY TUBE

1. Remove the e.h.t. oscillator top screen, remove the final anode socket from the top of the multiplier MPR1 and discharge the final anode and multiplier as detailed in section 5.2.7.
- WARNING:** Beware high voltages, observe precautions detailed in Section 5.2.7.
2. Unsolder the **ground lead for the final anode** and screen from pin 1101.
 3. Unclip the delay line from the two mounting clips on the top of the c.r.t. shield.
 4. Remove the brown plastic rear moulding.
 5. Remove the c.r.t. base and the side contact connectors (mark to assist replacement).
 6. Unsolder the **grounding braid connections between** the c.r.t. shield and the Y driver p.c.b. Note the positions for reassembly. This is important.
 7. Unclip the graticule from the front panel.
 8. Remove the trace rotation socket SKK. Ensure that the final anode (e.h.t.) lead is still connected to pin 2 of SKK (see Section 5.2.7).
 9. Remove the two screws securing the rear of c.r.t. shield to the e.h.t. assembly mounting bracket.
 10. Slide the c.r.t. and shield rearwards sufficiently to clear the support moulding at the front of the instrument and lift out.
 11. Release the c.r.t. from the shield, release the locking clamp at the rear of the shield and slide the tube forward, taking great care not to damage the side pins when doing this. Note that the leads to the trace rotation coil and the e.h.t. cable pass through grommets in the shield. Take care not to strain these leads. It is necessary to remove the contact inserts from the plastic housing of SKK in order to remove the cable. Do not knock or stress the shield as this can damage its magnetic properties.
 12. To replace the c.r.t. assembly, reverse the above procedure, but tighten the locking clamp last, after pushing the c.r.t. forward within the shield to meet the front panel moulding. **DO NOT** over-tighten this clamp as damage to the glass may result. Tighten only to the point where the rubber block is seen to distort.

WARNING: Although the danger of implosion

with this type of c.r.t. is slight, great caution should nevertheless be used when handling the c.r.t. It is advisable to wear protective clothing, in particular, some form of suitable eye protection.

5.2.10 SCALE ILLUMINATION LAMPS

1. Remove the instrument top cover.
2. Pull the lampholder(s) from the plastic moulding around the face of the c.r.t.
3. Pull the wedge shaped base lamp from its socket. The lamps are 12V 1W types, part number 40328.

5.2.11 COAXIAL CONNECTIONS

The instrument uses 13 coaxial leads for interconnection

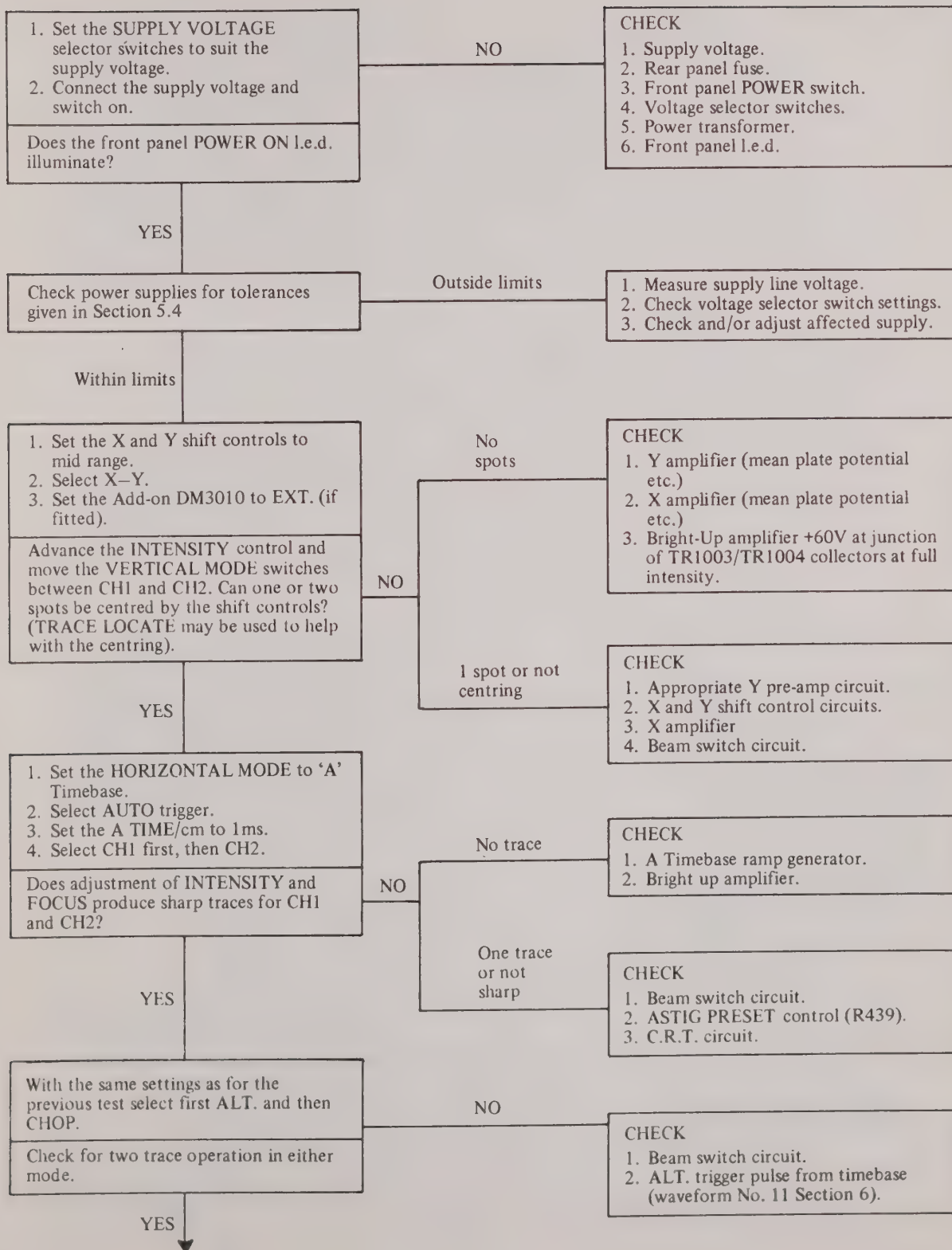
between assemblies which are coded with colored sleeves at each end for identification. The table in Fig. 5.1 shows the interconnection details. The first pin number in a pair refers to the inner conductor, the second to the screen.

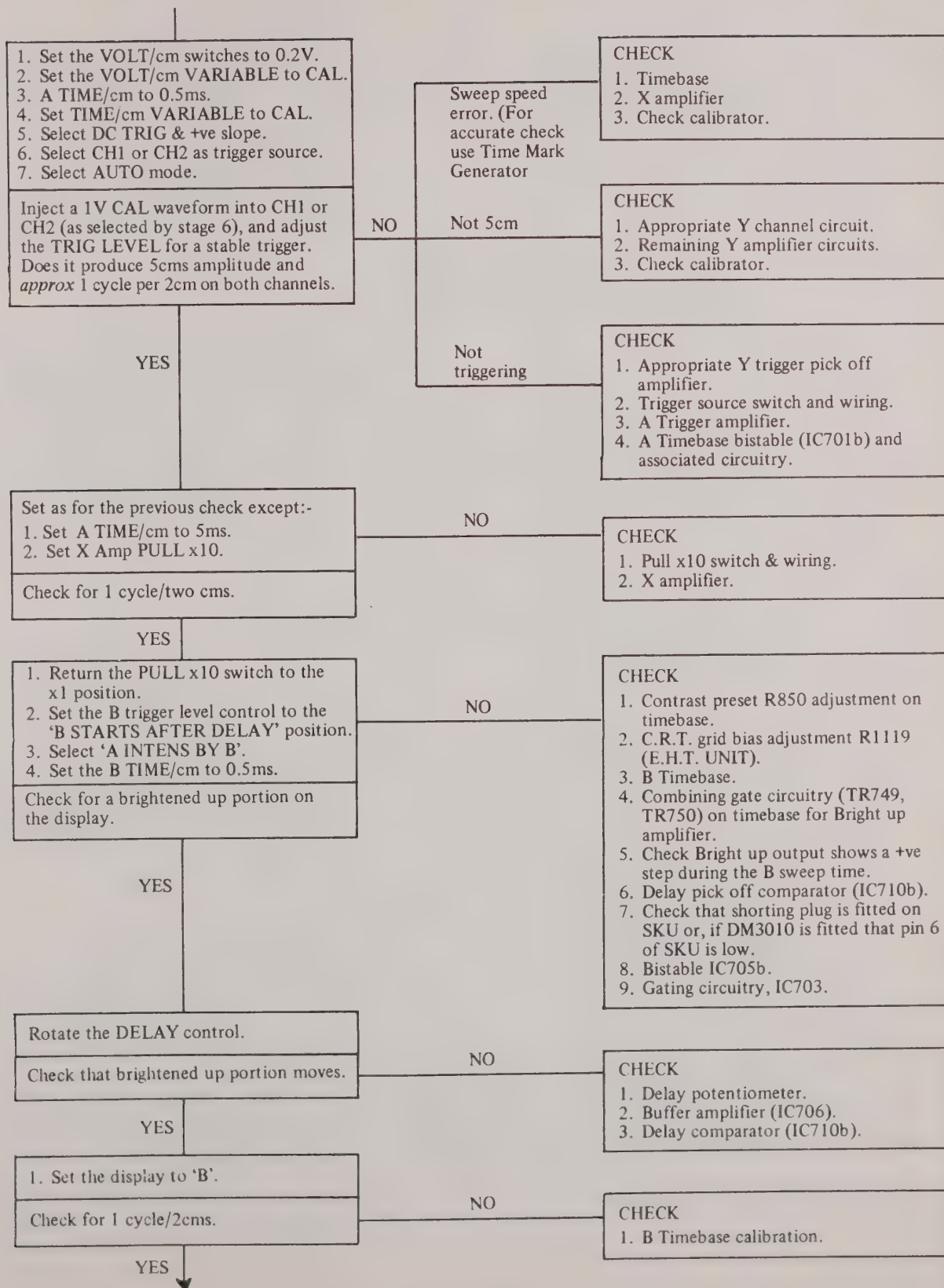
5.3 FAULT FINDING TABLES

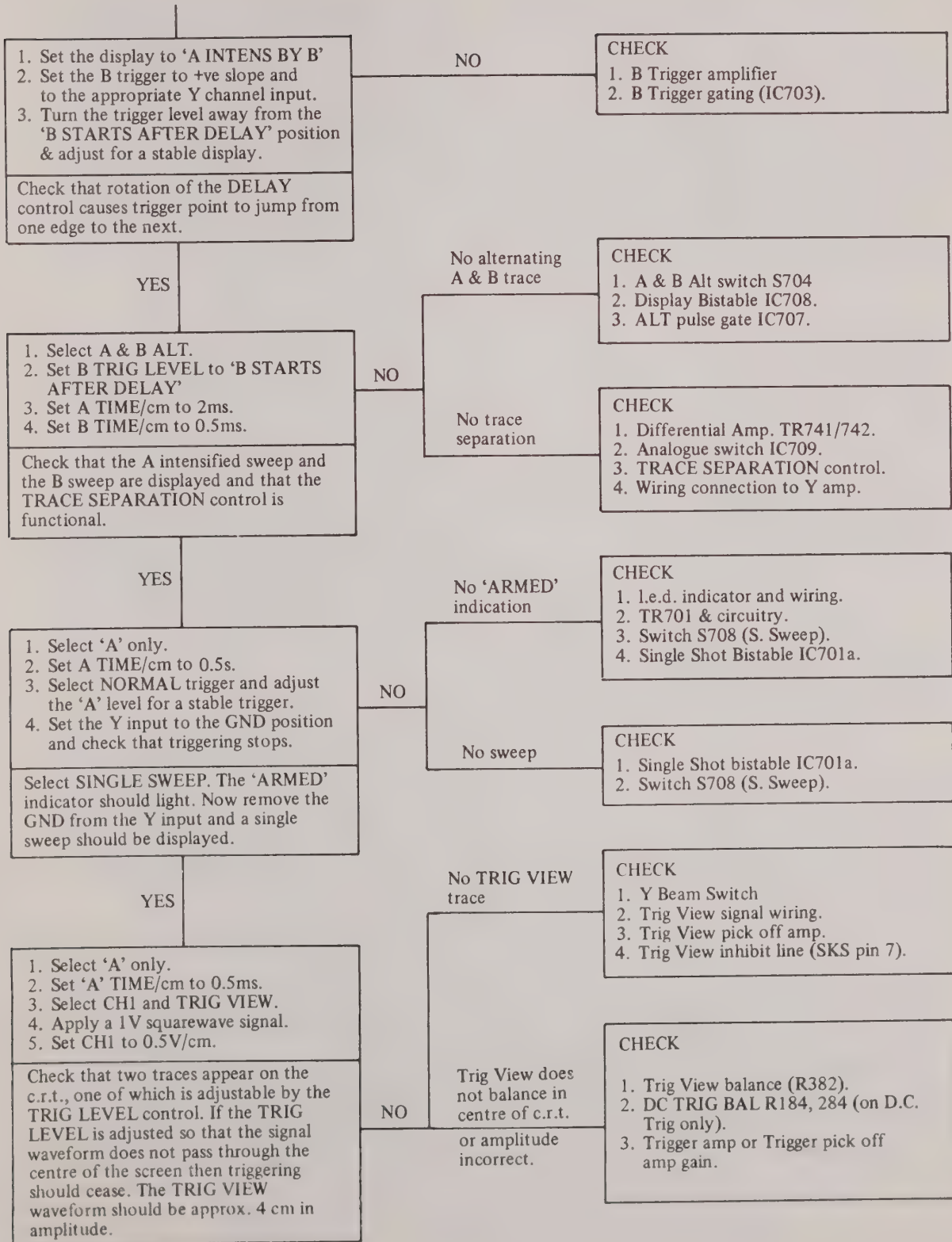
Fault finding is based initially on the characteristics of the fault and the tables of Section 5.3 define a suggested procedure to localize the fault to one particular area. Subsequent detailed guidance will be obtained from the relevant circuit diagram and circuit description and from the table of operating potentials in Section 5.4.

FROM	TO
'Y' Preamp p.c.b. pins 302, 301	Timebase p.c.b. pins 715, 716
'Y' Preamp p.c.b. pins 308, 309	Trigger source S511, a3, b3
'Y' Preamp trigger CH1	Trigger source S509, b3, b1
'Y' Preamp trigger CH2	Trigger source S512, b3, b1
'Y' Preamp p.c.b. pins 309, 0V and R308	Power supply p.c.b. pins 1014 and 1016
Ex-Atten p.c.b. pin 626, CAL	Timebase p.c.b. pins 711, 712
Back panel BNC socket (B GATE)	Timebase p.c.b. pins 718, 717
Back panel BNC socket (A RAMP)	Timebase p.c.b. pins 720, 719
Timebase p.c.b. pin 707, 708	Power supply p.c.b. pins 1013, 1015
Trigger source p.c.b. pins 601, 0V	Transformer pins 11 and 12
Timebase p.c.b. pins 703 and 704	Trigger p.c.b. pins 511 and 512
Timebase p.c.b. pins 705 and 706	Trigger p.c.b. pins 554 and 555
Timebase p.c.b. pins 709 and 710	Timebase p.c.b. pins 701 and 702

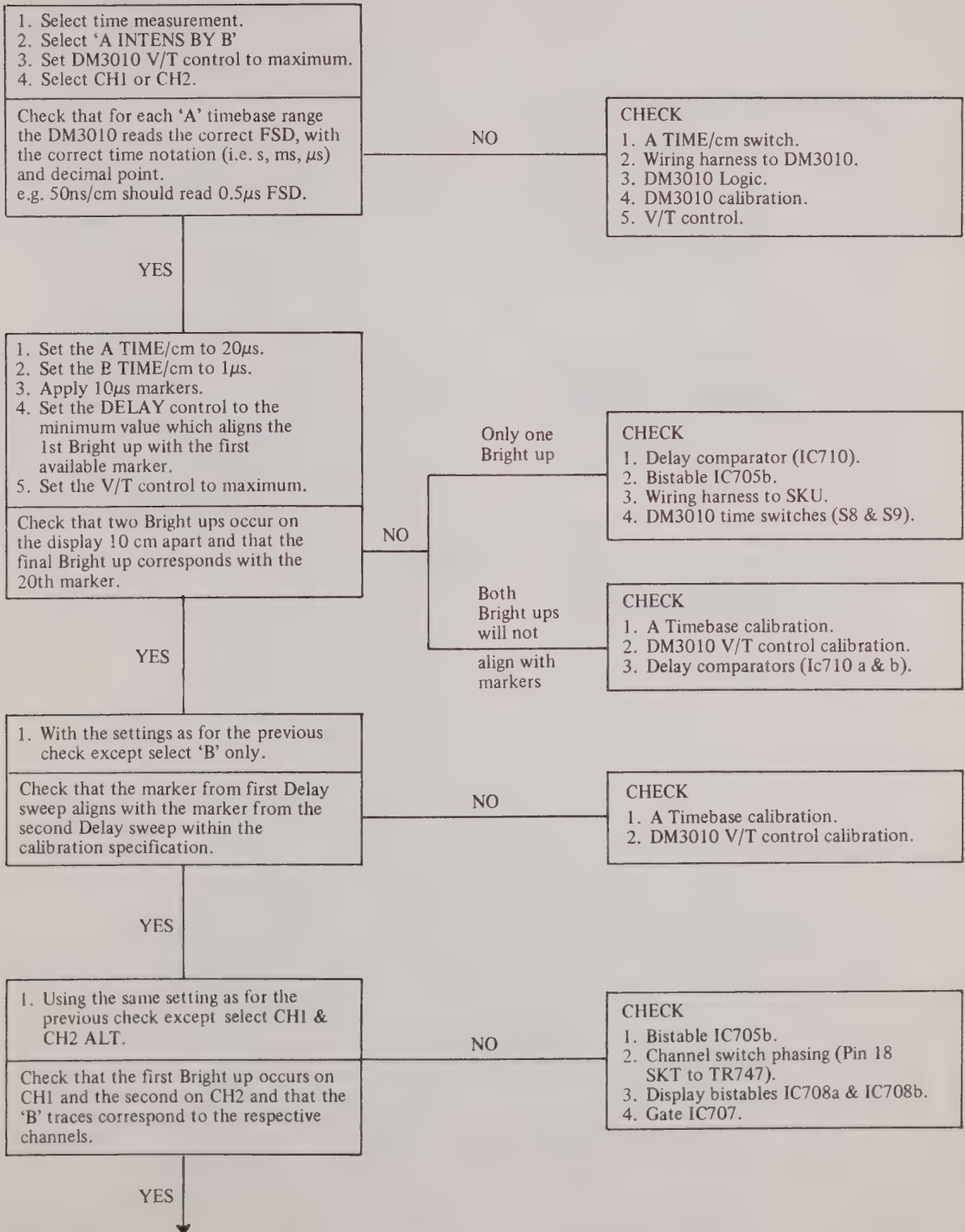
Fig. 5.1 Coaxial Lead Interconnection Data

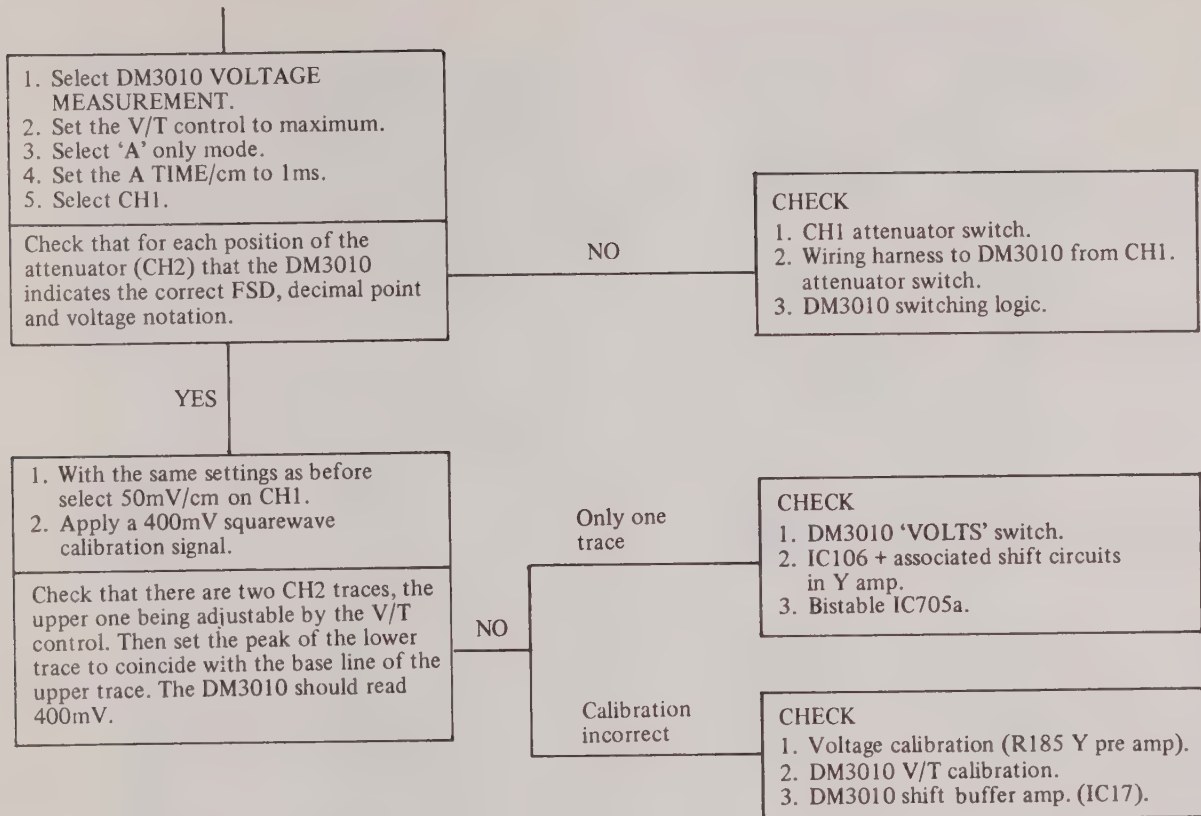






FOR INSTRUMENTS FITTED WITH DM3010





5.4 OPERATING POTENTIALS

Measurements are taken with the power supply input voltage at approximately the mid range of the supply voltage setting. The Y inputs are grounded and the amplifiers set to 2mV/cm sensitivity. The Timebase is set to A only and AUTO, with the trigger LEVEL control fully clockwise. The Y amplifier is set to CH1 only with the trace centred except where stated. To prevent possible oscillation measurements were taken with a 1k Ω resistor in series with the meter lead.

Y PREAMPLIFIER AND PREAMP TRIGGERCH1

Set DM3010 to NORMAL mode (if fitted)

TR102	EMITTER	-6.5V
TR103	BASE	+0.73V
IC101	PIN 6	-4.5V
IC102	PINS 1, 7	-0.8V
TR104, 105	EMITTERS	+3.3V
"	COLLECTORS	-5.2V
IC103	PINS 5, 6	-6.0V
"	PINS 1, 2, 9, 10	-1.25V
IC104	PINS 8, 11	+2.0V
"	PINS 3, 4, 5, 13	-5.3V
TR106	EMITTER	-4.6V
TR107	EMITTER	-5.25V
TR109	COLLECTOR	+0.89V
TR108	COLLECTOR	-9.5V
TR108, 109	EMITTERS	+6.8V
IC105	PINS 1, 5, 6, 9	-1.9V
"	PIN 3	-7.2V
TR110, 111	EMITTERS	-3.5V

CH2

CH2 only selected and trace centred.

TR202	EMITTER	-6.5V
TR103	BASE	+0.73V
IC101	PIN 6	-4.5V
IC102	PINS 1, 7	-0.8V
TR104, 105	EMITTERS	+3.3V
"	COLLECTORS	-5.2V
IC103	PINS 5, 6	-6.0V
"	PINS 1, 2, 9, 10	-1.25V
IC104	PINS 8, 11	+2.0V
"	PINS 3, 4, 5, 13	-5.3V
IC105	PINS 1, 5, 6, 9	-1.9V
"	PIN 3	-7.2V
TR110, 111	EMITTERS	-3.5V
IC107, 207	PINS 5, 6	+1.2V
IC301	PINS 5, 6	+0.2V
TR303, 304	BASES	+4.7V
IC302	PINS 8, 11	+5.6V
"	PINS 7, 9	+3.0V
IC302	PIN 3	+1.3V
TR312	EMITTER	+1.3V
IC307	PIN 11	+11.7V
IC307	PIN 8	0V

TR306	COLLECTOR	+0.2V
TR305	COLLECTOR	-0.1V

Y DRIVER AND OUTPUT

TR401, 402	COLLECTOR	-3.4V
TR403, 404	EMITTERS	-7.2V
"	COLLECTORS	+1.2V
Y DRIVER O/P	PINS 405, 409	+5.9V
Y OUTPUT	PINS 475, 476	+33V
*FOCUS	PLH (4)	-1.5kV approx.

*HIGH IMPEDANCE – REFOCUS AFTER CONNECTING METER

GEOMETRY	PIN 404	+20V approx.
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TRIGGER AMPLIFIER

Trig level controls (A and B) set to mid position, no trigger signal applied.

A CHANNEL

TR503	BASE	0V
TR507	BASE	-0.71V
TR508	BASE	-1.0V
TR507/508	COLLECTORS	+2.8V
TR506	EMITTER	+8.9V (XY sel.)
"	"	+1.9V (XY not sel.)
TR509, 510	COLLECTORS	-0.56V
TR513, 514	"	+3.6V
IC501	PIN 5	+3.6V (POS. TRIG)
"	"	+4.3V (NEG. TRIG)
"	PIN 10	+2.0V (POS. TRIG)
"	"	+3.6V (NEG TRIG)
TR515	EMITTER	-4.7V
TR517	EMITTER	-7.6V
TR511, 512	COLLECTORS	+5.5V (TRIG VIEW SEL)

B CHANNEL

TR522	BASE	0V
TR524	BASE	-0.74V
TR525	BASE	-1.0V
TR524/525	COLLECTORS	+3.6V
TR526	COLLECTORS	-1.2V
TR528/529	COLLECTORS	+3.0V
IC502	PIN 5	+4.3V (POS TRIG)
"	"	+3.6V (NEG TRIG)
"	PIN 10	+3.6V (POS TRIG)

” ” +2.0V
(NEG TRIG)

TIMEBASE

Readings are taken with A ONLY and NORMAL TRIG. modes selected with no trigger signal applied. All controls are in the CH1 position, except where stated.

TR714	BASE	+14.5V
TR738	”	+14.5V
TR714	”	+21V *
TR738	”	+21V *

* A & B variable TIME/CM fully anticlockwise

TR720	EMITTER	0V
TR710	”	-8.3V
TR703	”	+4V
TR735	”	0V
TR727	”	-8.6V
TR726	”	+3.0V
TR749	BASE	-2.2V
TR750	COLLECTOR	+30V

X OUTPUT AMPLIFIER

Readings are taken with the HORIZONTAL mode switched to X-Y, the A TRIGGER SOURCE to EXT and the X SHIFT adjusted for a spot in the centre of the c.r.t.

TR814	EMITTER	-11.8V
TR810/812	BASES	+1.8V
TR809, 811	BASES	+1.8V
TR813	EMITTER	-3.8V
TR805	BASE	+6.9V
TR806	”	+7.6V
TR807	”	+8.9V
TR808	”	+7.6V
TR801/803/802 /804	COLLECTORS	+60V

POWER SUPPLY

Readings are taken with the HORIZONTAL MODE switched to X-Y and the spot centred and just visible.

IC1001	ADJ	+10.8V
IC1002	ADJ	-10.8V
IC1004	PINS 1, 6, 10	+24V
”	PINS 7, 8	+30V
”	PIN 5	+12V
IC1003	ADJ	+3.8V
TR1005	COLLECTOR	+79V
TR1004	COLLECTOR	+15V
TR1003	COLLECTOR	-11V
PLA	PIN 5 (mean plate)	+30V
PLA	PIN 6 (ASTIG)	+30V approx.

C.R.T. FINAL ANODE

Remove the screen from the e.h.t. assembly. Remove and discharge the c.r.t. final anode socket from the voltage

multiplier MPR1. Measure the final anode voltage at the output from the multiplier.

MPR1	OUTPUT PLUG	14.3kV
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BEWARE HIGH VOLTAGE – OBSERVE ALL PRECAUTIONS LISTED IN SECTION 5.2.7.

5.5 CALIBRATION PROCEDURE

5.5.1 TEST EQUIPMENT

1. Variable autotransformer. Output voltage 95-260V at 1 A with r.m.s. voltmeter.
2. Digital multimeter 4½ digit with 1MΩ minimum input impedance and accuracy within 0.02%.
3. High voltage probe for multimeter capable of operation up to 20kV.
4. Voltage calibrator 1kHz square wave generator with amplitude range of 2mV to 50V ±0.2%.
5. Time mark generator. 10ns to 0.5s ±0.2%.
6. Fast rise squarewave generator. 100Hz to 1MHz flat top square wave generator with amplitude range 0.1V to 1V into 50Ω with rise time of less than 1ns.
7. R.F. sinewave generator 500kHz to 150MHz with 50kHz reference frequency. Output amplitude 10mV to 5Vpp into 50Ω, accuracy at 50kHz and 500kHz to 150MHz within 3%.
8. LF Sinewave generator.
9. Capacitance standardizer 1MΩ/25pF, BNC 50Ω terminations.
10. BNC – BNC connector lead (PL43).
11. Test oscilloscope, 10MHz bandwidth ≥ 5% accuracy ≤ 50mV/cm sensitivity with X10 low capacitance probe.

NOTE: Calibration should be carried out at 23°C ambient temperature after at least a 15 minute warm up period. All measurements are made with respect to chassis except where stated.

5.5.2 POWER SUPPLIES AND CALIBRATOR

1. Set the INTENSITY control to minimum.
2. Set the supply voltage switches in the rear panel to suit the supply. Apply the supply voltage via the variac and set to mid range of the supply voltage setting. (Check the correct supply fuse has been fitted).
3. Check the SCALE control varies the scale intensity and that the POWER ON l.e.d. is energized.
4. Connect the d.v.m. to pin 6 on PLD (power supply p.e.b.), set R1052 to give -12.00V.
5. Check the supply voltages on the following pins of PLD.

PLD (9)	5.0V $\pm 5\%$
PLD (4)	24.0V $\pm 5\%$
PLD (1)	+120V $\pm 6\%$
PLD (3)	-120V $\pm 6\%$

- Connect a d.v.m. to the anode (orange lead) of C1 (1000 μ F 100V) and check for 60V $\pm 6\%$.
- Briefly switch off the instrument, remove IC714 on the timebase p.c.b. and switch on again, connect the d.v.m. to the 1V CAL pin. Adjust R1051 on the power supply p.c.b. for 1.000Vd.c. output. Connect the d.v.m. to PLD(6) and check for +12V $\pm 2\%$. Briefly switch off the set, replace IC714 and switch on again. Confirm with an oscilloscope the presence of a square wave at the CAL output of frequency 1kHz $\pm 10\%$.

5.5.3 E.H.T. AND C.R.T. CUT OFF VOLTAGES

- Remove the screen from the e.h.t. oscillator.
- Connect the d.v.m. via the high voltage probe to the cathode (positive band) of D1114. Adjust R1106 for -2.2kV.

BEWARE HIGH VOLTAGE.

- Set the instrument to X-Y mode and center the spot on the screen. Adjust the INTENSITY control for +15V at the junction of the collectors of TR1003, TR1004 and R1022. The set R1119 for a just visible spot.
- Replace the e.h.t. screen.

5.5.4 Y MEAN PLATE POTENTIAL AND +7V SUPPLY

- Measure the +7V supply at pin 408 on the Y driver p.c.b., check for +7V $\pm 0.5V$, if necessary adjust R425 (A.O.T.) to achieve this.
- Set trace to centre line. Measure the Y plate voltages and finely adjust the Y shift control to equalize the voltages. Check the voltage lies in the range +29 to 33V. Adjust R456 (A.O.T.) if necessary.

5.5.5 TRACE ALIGNMENT GEOMETRY AND ASTIGMATISM

- Set the instrument to 1ms/cm, 50mV/cm with trigger to AUTO timebase to A ONLY and Y MODE to CH1.
- Ground CH1 input and centre trace, adjust TRACE ROTATE control for a horizontal trace. (It may be necessary to reverse SKV).
- Set CH1 input to AC. Apply a 1MHz sinewave of approximately 400mV amplitude. Trigger the signal and adjust the GEOM preset R440 for best compromise of the X and Y edges at the extreme edges of the graticule.
- Apply a 1kHz sinewave of approximately 400mV amplitude. Trigger the waveform and adjust the ASTIG preset R439 in conjunction with the FOCUS

control for the finest trace at low intensity.

- Recheck the geometry setting.

5.5.6 SCALE ILLUMINATION

Check both lamps are operating, replace if showing signs of blackening. Check that brilliance is fully variable.

Y AMPLIFIER ADJUSTMENTS

5.5.7 CHANNELS 1 & 2 – AC/DC EQUALIZATION

- Set the instrument to CH1 only, 10mV/cm sensitivity d.c. coupled, triggered from CH1 a.c. coupled, A timebase only 5ms/cm.
- Apply a 100Hz square wave via 25pF capacitance standardizer and adjust R178 for a flat top to the waveform.
- Repeat for R278 for channel 2.

5.5.8 CHANNELS 1 & 2 – DC STEP ATTENUATOR BALANCE

- Set to CH1 only, 20mV/cm sensitivity, input grounded, A timebase free running (AUTO).
- Center the trace and adjust R179 so that there is no trace movement when the attenuator is switched between 20mV/cm and 50mV/cm.
- Repeat for Channel 1 2/5mV balance adjusting R180.
- Repeat for Channel 2, 20/50mV balance adjusting R279.
- Repeat for Channel 2, 2/5mV balance adjusting R280.

5.5.9 CHANNELS 1 & 2 – INVERT BALANCE

- Set the instrument as for 5.5.8 1. above.
- Center the trace and adjust R182 for no movement when the invert switch is operated.
- Repeat for Channel 2, adjusting R282.

5.5.10 OUTPUT BALANCE

- Set the instrument to CH1 only, 10mV/cm.
- Apply 100MHz from the generator and adjust for 4cm display. Trigger the waveform.
- Adjust R341 so that any limiting that occurs as the shift control is operated is symmetrical about the center of the graticule.

5.5.11 ADD MODE BALANCE

- Set the instrument to DUAL, free run the timebase and center both traces.
- Check that when ADD is selected trace movement is less than 5mm. If necessary, adjust either R333 (A.O.T.) or R334 (A.O.T.) to achieve this.

5.5.12 CHANNELS 1 & 2 GAIN CALIBRATION

- Set the instrument to CH1 only, 10mV/cm. Apply

a 50mV peak to peak squarewave from an oscilloscope calibrator, set the timebase to a suitable speed and trigger the waveform. Adjust R181 for exactly 5cm amplitude.

2. Set the instrument to 2mV/cm. Apply 10mV p.p. and adjust R183 for exactly 5cm amplitude.
3. Check the variable gain pot reduces the display amplitude to between 1 and 2cm, and is smooth in operation. Check the "UNCAL" i.e.d. operates.
4. Repeat step 1 for CH2 adjusting R281.
5. Repeat step 2 for CH2 adjusting R283.
6. Repeat step 3 for CH2.

5.5.13 CHANNELS 1 & 2 ATTENUATOR COMPENSATION

1. Select CH1 only 0.1V/cm, set the calibrator to give 5cm amplitude, adjust C65 for a square corner.
2. Select 1V/cm sensitivity, reset the calibrator and adjust C67 for a square corner.
3. Fit a 25pF capacitance standardizer in series with the input, select 10mV/cm sensitivity and adjust C69 for a square corner.
4. Select 0.1V/cm and repeat adjusting C71.
5. Select 1V/cm and repeat adjusting C73.
6. Select CH2 only and repeat steps 1–5 above, adjusting C66, 68, 70, 72, 74 respectively.

5.5.14 CH1 & CH2 ATTENUATOR ACCURACY

Using the calibrator, check all attenuator ranges on both channels for $\pm 3\%$ accuracy and square corner.

5.5.15 CH1 & CH2 INVERT SWITCHES

Invert a 5cm square wave and check that the amplitude does not change.

5.5.16 CH1 & CH2 INPUT LEAKAGE

Select 2mV/cm sensitivity and check that the trace movement when the input coupling is switched from DC to GND is less than 1mm on both channels.

5.5.17 Y AMPLIFIER PULSE RESPONSE

NOTE: If there is any reason to suspect that there are significant timebase H.F. calibration errors, these should be checked and rectified before proceeding further as the pulse response measurements will otherwise be invalid.

1. Select Channel 1, 10mV/cm, d.c. coupled A timebase only to 0.1 μ s/cm. Apply a 1ns risetime pulse, 1MHz repetition rate via a 50 Ω termination and adjust the level to give about 5cm amplitude.
2. Adjust C125 and C313 on the pre-amplifier and C408 and 409 on the output driver for optimum pulse responses paying particular attention to obtaining a square corner. It will be necessary to adjust each trimmer several times to achieve the best compromise.

3. Select Channel 2 10mV/cm d.c. coupled and adjust C225 for optimum pulse response, also readjusting C313 if necessary to obtain the best compromise and similarity between both channels.
4. Recheck channel 1 and readjust C125 if necessary.
5. Check the risetime < 3.5 ns on both channels.
6. Recheck the pulse response with a 100kHz repetition rate pulse.

5.5.18 Y BANDWIDTH

1. Select channel 1 10mV/cm sensitivity d.c. coupled. Connect a constant Amplitude Generator via a 50 Ω termination.
2. Switch to the reference frequency and adjust for 5cm deflection. Increase the generator frequency until the amplitude displayed drops to 3.5cm. The frequency should be greater than 100MHz.
3. Check the bandwidth on the 50mV, 20mV, 5mV and 2mV ranges. All should be greater than 100MHz, except the 2mV range which should be greater than 85MHz.
4. Repeat the procedure for channel 2. Should the bandwidth prove inadequate recheck the pulse response, paying particular attention to obtaining a square corner.

TIMEBASE ADJUSTMENTS

5.5.19 X MEAN PLATE POTENTIAL

1. Set the timebase to 0.1ms/cm x1, A only, the trigger to AUTO and the trigger level for a stable trace.
2. Adjust shift control to bring the start of the trace to the center of the screen. Using the test oscilloscope, check that the sweep start voltage on each plate lies between +26V and +32V. Adjust AOT resistor R972 if necessary to achieve this.
3. Repeat for x10 expansion, adjusting R971 if necessary.

5.5.20 PRESET CONTRAST

1. Set the timebase to A intensified by B, 0.2ms/cm (A), 50 μ s/cm (B), delay to 3.0.
2. Adjust R850 for 8V "B" bright-up step at the junction of the collectors of TR1003 and TR1004 measured with the test oscilloscope. These transistors are on the power supply p.c.b. BEWARE HIGH VOLTAGE ON THE P.C.B.

5.5.21 A TRIGGER BALANCE ADJUSTMENTS

1. Set the instrument to AC, CH1, A only, 0.1ms/cm and AUTO. Apply a 10kHz sinewave of about 6cm amplitude on the display, set the A TRIGGER LEVEL to center and the input to AC TRIGGER coupling, with CH1 as source. Adjust R520 on the

trigger p.c.b. for the trace to start approximately central in the waveform.

2. Set the TRIGGER COUPLING to DC, adjust R184 (DC TRIG. BAL.) on the Y preamplifier p.c.b. for no trigger level movement between DC coupling and AC coupling. Select the TRIGGER SOURCE to CH2, apply the input signal and repeat the procedure with R284 (CH2 DC TRIG. BAL.).
3. Select CH1 and CH2 ALTERNATE, Y inputs to AC and position both traces central on the graticule. Apply the same 10kHz input to both channels. Select COMPOSITE TRIGGER SOURCE and adjust R356 (COMP. TRIG. BAL.) on the preamplifier p.c.b. for no trace movement between AC and DC trigger coupling.
4. Select CH1 and apply a low level signal to occupy about 2mm of trace. Adjust the trigger level for stable trigger and select the TRIGGER VIEW facility. Adjust the TRIGGER VIEW BALANCE R382 for a "TRIGGER VIEW" trace in the center of the c.r.t.

5.5.22 B TRIGGER ADJUSTMENT

1. Select CH1, AC TRIGGER SOURCES A to B to CH1, with TRIG COUPLING on AC. Set A timebase to 0.2ms/cm and B timebase to 0.1ms/cm. Select A INTENS BY B.
2. Adjust the A TRIGGER LEVEL control for a stable trigger with a 10kHz sinewave applied to CH1. (about 6cms).
3. Adjust the B TRIGGER LEVEL control for an intensified B trace. Change the HORIZONTAL MODE to B ONLY.
4. Set the B TRIGGER LEVEL control to center and adjust R609 (B TRIG LEVEL BAL) for the start of trace to commence at the mid-point of the sinewave amplitude. Return to A ONLY and B STARTS AFTER DELAY.

5.5.23 EXTERNAL X A COMPENSATION

1. Set TRIGGER SOURCE to EXT and the VERTICAL MODE to TRIG VIEW, TRIGGER COUPLING to DC. Apply no LF or HF REJECT.
2. Apply a 0.25V 1kHz square wave from the calibrator to the EXT A input and adjust C588 for a square corner on the waveform.
3. Apply 0.5V 1kHz via a 25pF standardizer and adjust C589 for a flat top to the waveform.
4. Apply a 2.5V 1kHz direct, select EXT ÷ 10 and adjust C545 and C547 for a square corner and flat top.

5.5.24 EXTERNAL X B COMPENSATION

1. Center the B TRIG LEVEL control. Set the TRIGGER SOURCE to EXT and TRIGGER

COUPLING TO DC. Connect the probe of the test oscilloscope to the emitter of TR522.

2. Apply a 2.5V 1kHz square wave from the calibrator to the EXT B input and adjust C581 for a square corner to the displayed waveform.
3. Apply 5V 1kHz via the standardizer and adjust C583 for a flat top to the waveform.
4. Apply 5V 1kHz direct, select EXT ÷ 10 and adjust C562 and C563 for a square corner and flat top.

5.5.25 A TIMEBASE CALIBRATION

1. Set the Y VERTICAL MODE to CH1 with input at DC, 1V/cm. Set the HORIZONTAL MODE to 'A INTENS BY B'. A TIME/cm to 1ms, B TIME/cm to 1μs.
2. Using the digital multimeter set on the 10V range apply to the tags of the DELAY control which connect to pins 10 and 11 of SKV. Adjust R915 for a reading of 4.00 volts.
3. Set the DELAY control to minimum and adjust the X shift control for the intensified trace to begin at the first graticule vertical marking. Set the DELAY control to maximum and adjust R960 for the intensified trace to begin on the last graticule vertical marking. Return the DELAY control to minimum again and check the intensified trace alignment with the first vertical. Re-adjust R960 as necessary such that full adjustment of the DELAY control gives 10cm of movement on the intensified trace ±2mm.
4. Select 'A' only and apply 0.1ms markers from the TIME/MARK GENERATOR to the CH1 input. Adjust R767 for 1 pulse/cm with the A TIME/cm set at 0.1ms/cm.
5. Apply 1μs markers, set the A TIME/cm to 1μs/cm and adjust C722 for 1 pulse/cm.
6. Apply 1ms markers, set the A TIME/cm to 1ms/cm and adjust R761 for 1 pulse/cm.
7. Apply 10μs/cm markers, set the TIME/cm to 0.1ms/cm, pull x10 switch and adjust R957 for one pulse/cm.
8. Set the trimmers C815 and C816 for minimum, and apply 10ns markers. The A TIME/cm should be set to 50ns/cm and the x10 switch pulled on, set C815 and C816 by adjusting in equal amounts of capacitance on each such that the best trace linearity and accuracy are obtained. One pulse every 2cm should be displayed.

5.5.26 B TIMEBASE CALIBRATION

1. Select the HORIZONTAL MODE to 'B' and apply an input of 0.1ms markers. Set the A TIME/cm to 0.2ms/cm and the B TIME/cm to 0.1ms/cm. The DELAY control should be set to zero and the 'B TRIGGER LEVEL' at the B STARTS AFTER

DELAY position. Adjust R833 for one pulse/cm.

2. Apply 1 μ s markers, set the A TIME/cm to 2 μ s/cm and the B TIME/cm to 1 μ s/cm. Adjust C741 for 1 pulse/cm.
3. Apply 1ms markers, set the A TIME/cm to 2ms/cm and the B TIME/cm to 1ms/cm. Adjust R816 for 1 pulse/cm.
4. Set the A TIME/cm to 0.2ms/cm and the B TIME/cm to 0.1ms/cm. Select A & B ALTERNATE MODE, check that the A trace and B trace start within ± 2 mm of each other. If not, change R827 (nominally 470 Ω) AOT to suit. R827 should be changed to 560 Ω if the B trace starts early or to 390 Ω if it starts late.

5.5.27 X-Y CALIBRATION

1. Apply a 160mV 1kHz square wave signal at CH1 with the CH1 attenuator at 20mV/cm and input d.c. coupled. Select CH2 VERTICAL MODE & GROUNDED, CH1 TRIGGER SOURCE AND DC TRIGGER COUPLING.
2. Select X-Y MODE and adjust R512 on the Trigger p.c.b. for exactly 8cm of horizontal display. (Note the calibration specification CH1 $\pm 5\%$ CH2 $\pm 15\%$).

5.5.28 X-Y PHASE ALIGNMENT

1. Apply 5cms of 50kHz reference signal from an HF signal generator to CH1 & CH2 inputs. A 45° line trace should now be visible on the c.r.t.
2. Increase the frequency to 500kHz and the line may be observed to open out to an ellipse. Adjust the value of C506 (220pF) AOT for the ellipse to close to a line again. Check that the line does not separate more than 2mm for frequencies up to 500kHz.

5.6 CALIBRATION PROCEDURE WITH DM3010 OPTION

NOTE: It is assumed that the oscilloscope has been set according to the calibration details and that the internal set up procedure for the DM3010 has been followed in accordance with the DM3010 handbook.

5.6.1 TIMEBASE – TIME MEASUREMENT CALIBRATION

This setting procedure for the timebase with the DM3010 involves some repetition of oscilloscope adjustments described in Section 5.5 of this handbook but with the special requirements of the add on d.v.m. and the greater setting accuracy needed. All variable controls should be set to the CAL positions.

1. Select CH1 VERTICAL MODE with INPUT COUPLING at DC and Y sensitivity at about 1V/cm (suitable to display about 5cm of Time-mark Generator amplitude).
2. Insert the Timemark Generator to CH1 input. Set the HORIZONTAL MODE to A INTENS BY

B. Set the A TIME/cm to 0.1ms and the B TIME/cm to 1 μ s. Apply 10 μ s markers.

3. Set the DELAY control to near to minimum on the oscilloscope and the v/t control on the DM3010 control to minimum. Select TIME MEASURE and INPUT SCOPE on the DM3010.
4. Pull the X $\times 10$ switch and observe the bright-ups at the beginning of the sweep. Adjust R96 on the DM3010 for alignment of the two bright-ups. The slope of the marker signal is useful for achieving this. Adjust the oscilloscope DELAY control to align with the leading edge of the first marker, and the R96 for coincidence.
5. Turn the front panel v/t control to its fully clockwise end. Using the 4½ digit DVM, measure the voltage between pin 11 (the wiper of R18) and pin 10 (0V). Adjust R54 in the DM3010 for a reading of 4.000V.
6. Apply 0.1ms markers. Return the $\times 10$ switch to the $\times 1$ position. Increase the v/t control to maximum. The DM3010 should display 1.000ms ± 12 digits. Adjust R960 (X AMPLIFIER $\times 1$ GAIN) for the two bright-ups to appear exactly 10cms apart. Adjust preset R767 so that 1 marker/cm is displayed.
7. Apply 50 μ s markers. Advance the DELAY control (OS3600) such that the first bright-up occurs on the first available marker and check that the 21st available marker is intensified by the second bright-up. Now press the B ONLY mode. Readjust R767 for exact coincidence of the two B traces.
8. Return the v/t control to read 0.500ms and check that the 11th marker is displayed. (Return to the A INTENS B position to check this). Adjust the v/t control for coincidence of the 1st and 11th markers on the B traces and check that the DM3010 reads 0.500ms ± 7 digits. Return the v/t control to maximum.
9. Set the A TIME/cm switch to 1 μ s and the B TIME/cm to 100ns. Apply 500ns markers. Select the A INTENS BY B mode. Set the DELAY control for the first bright-up to occur on the first available marker. With the v/t control on the DM3010 set at maximum, adjust C722 on the OS3600 timebase p.c.b. for two markers/cm to be displayed. The second bright-up should now occur coincident with the 21st available marker. Select the B ONLY mode and apply final adjustment to C722 so that the two B traces coincide. The DM3010 should now read 10.00 μ s ± 12 digits.
10. Set the DM3010 v/t control so that the 11th marker is displayed. (Referring back to the A INTENS BY B position) and align the two B traces. The DM3010 should read 5.00 μ s ± 7 digits.
11. Since the presets C722 and R767 are slightly interactive (by approx $\pm 0.1\%$) it is best to re-check the

calibration at step 7, readjusting R767 if necessary.

12. Set the A TIME/cm switch back to 1 μ s/cm again and apply 100ns markers. Select A INTENS BY B (or A ONLY) and pull the x10 switch on the X SHIFT control. Adjust R957 (X x10 GAIN CONTROL) for 1 marker/cm.
13. Set the A TIME/cm switch and the B TIME/cm switch to 50ns. Apply 10ns markers. With the x10 function still selected and the X SHIFT control approximately central, adjust the trimmers C815, C816 for one marker every two centimetres. This is most easily done by firstly setting the trimmers to minimum capacitance and then adjusting each by the same amount of capacitance until the best linearity and accuracy can be obtained.
14. Select the A INTENS BY B position and return the X SHIFT switch to the x1 position. With the same setting as for the previous test, adjust the v/t control on the DM3010 to MINIMUM. Set the DELAY control (OS3600) to align with the leading edge of the first available marker. Pull the x10 control again and select the B ONLY mode. By connecting a small trimmer 0–20pF across the appropriate A.O.T. pins C754 or C755 set the two B traces for alignment. Remove the trimmer measure its value and replace it by a fixed capacitor of nearest preferred tolerance. The B trace alignment should now be within 1ns. This adjustment equalizes for differential delay which may exist between the two comparators IC710a and IC710b. Note that if B trace coincidence is already within 1ns no adjustment need be made.
15. Apply 0.5ms markers. Set the A TIME/cm to 1ms and the B TIME/cm to 0.1ms. Select A INTENS BY B and return the x10 switch to the x1 position. Set the DM3010 v/t control to maximum. Adjust the DELAY control (OS3600) to align the first bright-up on the first available marker. Adjust R761 for 2 markers/cm with the second bright-up occurring on the 21st available marker. Now select B ONLY adjust R761 for coincidence of the B traces. The DM3010 should now indicate 10.00ms $\pm$ 12 digits.
16. Set the DM3010 v/t control to display the 11th marker pulse (using the A INTENS BY B mode). Align the v/t control for coincidence of the B traces on the B ONLY mode and check that the DM3010 reads 5.00ms $\pm$ 7 digits.
17. Check the DM3010 calibration with the OS3600 oscilloscope on the remaining timebase ranges to be within the specification accuracy. Also check that the full scale indication of the DM3010 is 10 times the A TIME/cm reading.

5.6.2 TIMEBASE – FREQUENCY CALIBRATION

The additional calibration is required for the $\frac{1}{T}$ (FREQUENCY) function. Correct operation of each range

should be checked by setting the v/t control for a 1cm delay in the TIME mode and then check each A Time-base range for an equivalent full scale display in the $\frac{1}{T}$ (FREQUENCY) mode. Repeat for 10cm display, checking for the equivalent $\frac{1}{10}$ full scale display.

5.6.3 Y DEFLECTION – VOLTAGE CALIBRATION

1. Select A ONLY, 0.5ms/cm and CH1 display and trigger, AC INPUT COUPLING. Select 'SCOPE' input and volts measurement. Set the CH1 attenuator switch to 10mV/cm.
2. Apply a 100mV calibration signal (1kHz square wave) and set the v/t control on the DM3010 to maximum. Adjust the Y CH1 shift approximately to set the top peaks of the lower (scope Y shift) trace with the bottom peaks of the DM3010 Y-shifted trace approximately in the centre of the c.r.t. display. Adjust R185 so that the top 'SCOPE' Y shift peaks occur on the same horizontal line as the DM3010 bottom peaks (as set by the v/t control). See Fig. 5.2. It is useful to adjust to the horizontal center line of the graticule to achieve this.
The DM3010 should now read 100.0mV.
3. Now apply a 50mV calibration signal and re-adjust the DM3010 v/t control for trace coincidence as in step 2. Check that the DM3010 reads 50.0mV $\pm$ 12 digits.
4. Check all the remaining CH1 VOLTS/cm ranges for calibration accuracy as per step 2 to be within specification noting that the F.S.D. of the DM3010 reads 10 scale divisions in each case.

NOTE that the dynamic range of the oscilloscope amplifier limits the accuracy at extremes of signal input, i.e. beyond 8cm deflection from the centre. For this reason the above calibration uses a 10cm pk/pk signal a.c. coupled. D.C coupling of a unipolar 10cm signal would cause inaccuracy.

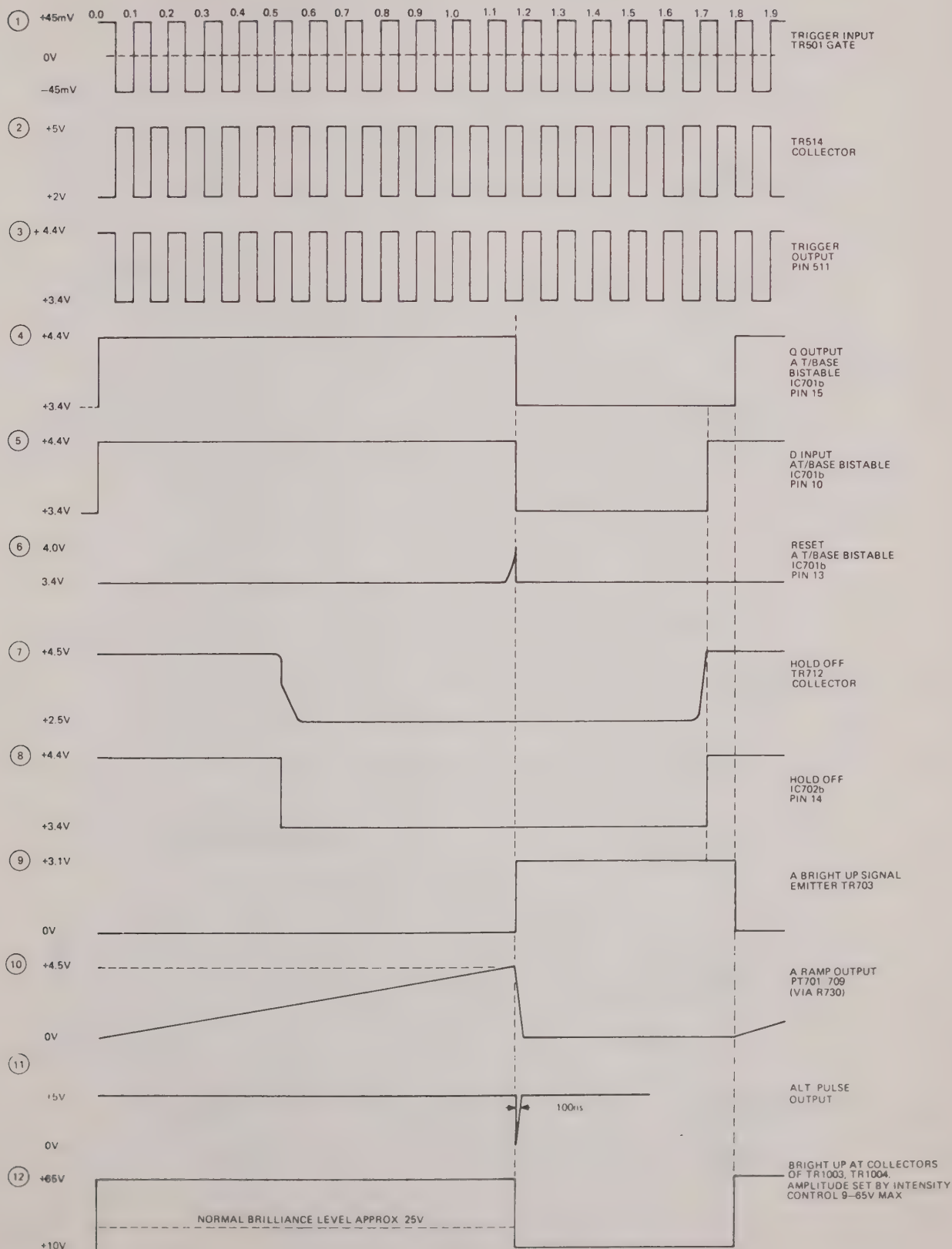


Fig. 2 T/B Waveforms Normal 'A' Sweep

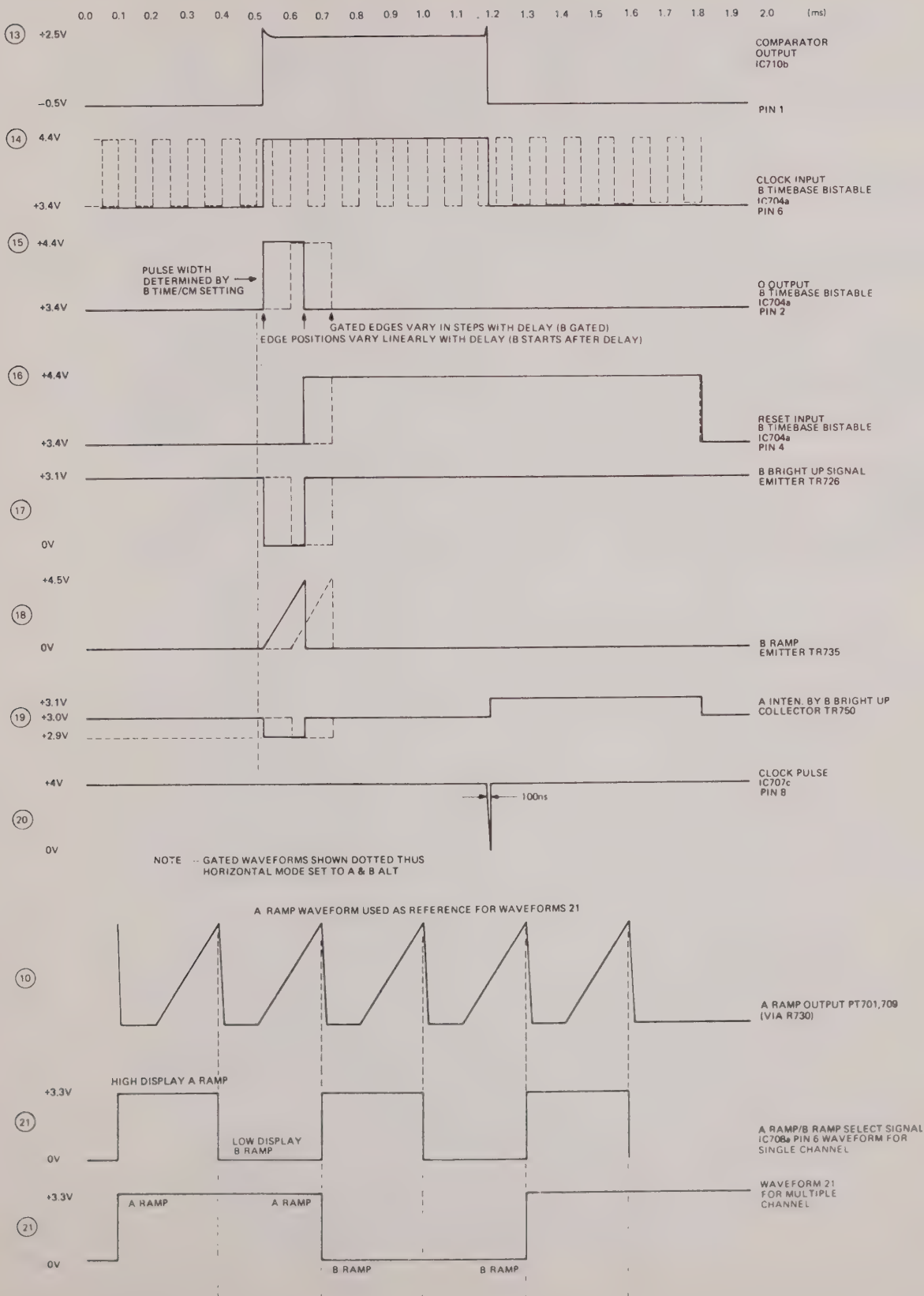


Fig. 3 T/B Waveforms Dual Operation

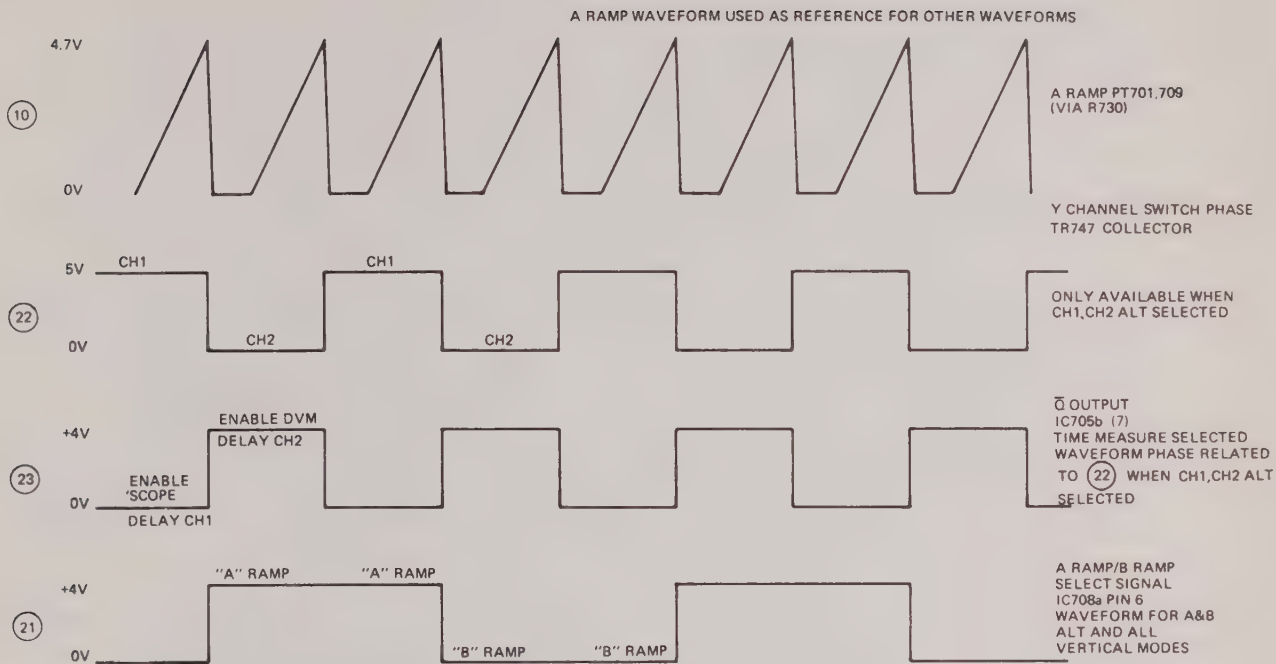


Fig. 4 T/B Waveforms DM3010 Time

A RAMP. WAVEFORM USED AS REFERENCE FOR OTHER WAVEFORMS

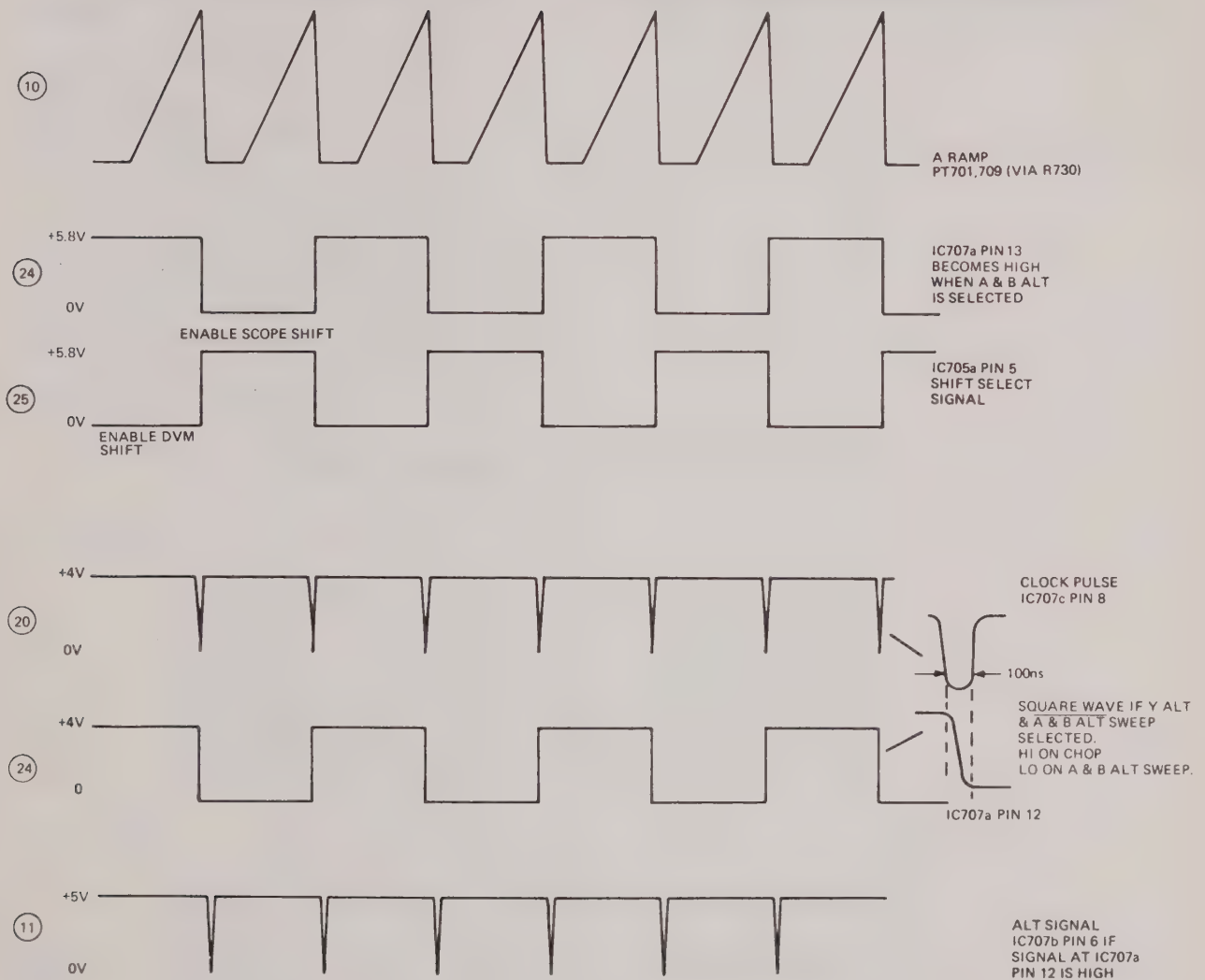


Fig. 5 T/B Waveforms DM3010 Voltage

SPARES ORDERING

When ordering spare parts, always give the following information:

- 1) Instrument model number
- 2) Serial number
- 3) Gould part number
- 4) Schematic reference number
- 5) Description of part

In its programme of developing new and better products, Gould may make changes in component types and other parts. In most cases these components will be interchangeable with those in instruments already in the field. However, where necessary, minor modifications may be required. Contact your Gould Service Center for advice.

Most components have internationally available equivalents.

NOTE: All part numbers shown in this manual shall be prefixed with AD2, i.e., 37898 should be AD237898.

ABBREVIATIONS USED FOR COMPONENT DESCRIPTIONS

RESISTORS

CC	Carbon Composition	$\frac{1}{2}W$	10%	unless otherwise stated
CF	Carbon Film	$\frac{1}{4}W$	5%	unless otherwise stated
MO	Metal Oxide	$\frac{1}{2}W$	2%	unless otherwise stated
MF	Metal Film	$\frac{1}{4}W$	2%	unless otherwise stated
MG	Metal Glaze		5%	unless otherwise stated
WW	Wire Wound	6W	5%	unless otherwise stated
CP	Control Potentiometer		20%	unless otherwise stated
PCP	Preset Potentiometer Cermet		20%	unless otherwise stated

CAPACITORS

CE(1)	Ceramic		+40% -20%	unless otherwise stated
CE(2)	Ceramic	500V	$\pm 10\%$	unless otherwise stated
CE(3)	Ceramic	50V	$\pm 10\%$	unless otherwise stated
SM	Silver Mica	350V		
PF	Plastic Film		$\pm 10\%$	unless otherwise stated
PS	Polystyrene	63V	$\pm 2\frac{1}{2}\%$	unless otherwise stated
PE	Polyester		$\pm 10\%$	unless otherwise stated
PC	Polycarbonate			
E	Electrolytic (aluminum)		+50% -10%	unless otherwise stated
T	Electrolytic (solid tantalum)		+50% -10%	unless otherwise stated
FT	Foil Trimmer			unless otherwise stated

Component List and Illustrations

Section 6

OS3600 TRIGGER

Ref	Value	Description	Tol %±		Part No	Ref	Value	Description	Tol %±		Part No
RESISTORS						RESISTORS (Cont)					
R15	1.1k	MF	0.5	1/8W	41784	R549	56	CF			28715
						R550	150	CF			28719
R23	27	CF			28711	R551	150	CF			28719
R24	27	CF			28711	R552	3k3	CF			21803
R25	22	CF			28710	R553	10	CF			21793
R26	22	CF			28710	R554	3k3	CF			21803
						R555	10	CF			21793
R501	390k	MF			38656	R556	22	CF			28710
R502	100	CF			21794	R557	100	CF			21794
R503	560	CF			21798	R558	22	CF			28710
R504	390	MF			38584	R559	22	CF			28710
R505	390	MF			38584	R560	10	CF			21793
R506	560	CF			21798	R561	1k	CF			21799
R507	6k8	CF			21807	R562	27	CF			28711
R508	820	CF			28724	R563	27	CF			28711
R509	1k5	MF			38598	R564	270	CF			28720
R510	2k	MF			38601	R565	270	CF			28720
R511	910	MF			38593	R566	2k2	CF			21802
R512	500	PCP			39232	R567	390	CF			28722
R513	6k8	MF			38614	R568	47	CF			28714
R514	12k	MF			38620	R569	330	CF			28721
R515	120	CF			28718	R570	330	CF			28721
R516	82	CF			28717	R571	330	CF			28721
R517	1k8	CF			28725	R572	300	CF			38581
R518	100k	CF			21819	R573	560	CF			21798
R519	10	CF			21793	R574	1k5	MF			38598
R520	20k	PCP			39235	R575	1k2	MF			38596
R521	5k6	CF			21806	R576	390	MF			38584
R522	22k	CP	“A” Trig Level		38676	R577	330	CF			28721
R523	4k7	CF			21805	R578	47	CF			28714
R524	100	CF			21794	R579	47	CF			28714
R525	3k3	CF			21803	R580	430	MF			38585
R526	1k	MF			38594	R581	10	CF			21793
R527	680	CF			28723	R582	47k	CF			21815
R528	62	MF			38565	R583	12k	CF			21810
R529	47	CF			28714	R584	68k	CF			21816
R530	47	CF			28714	R585	560k	CF			32359
R531	180	MF			38576	R586	270	CF			28720
R532	180	MF			38576	R587	470	CF			21797
R533	820	CF			28724	R588	100k	CF			21819
R534	560	CF			21798	R589	10k	CF			21809
R535	10k	CF			21809	R590	56	CF			28715
R536	10	CF			21793	R591	1k5	CF			21801
R537	10	CF			21793	R592	8k2	CF			21808
R538	56	CF			28715	R593	270	CF			28720
R539	56	CF			28715	R594	3k9	CF			21804
R540	39	CF			28713	R595	2k2	CF			21802
R541	39	CF			28713	R596	680	CF			28723
R542	680	CF			28723	R597	10	CF			21793
R543	820	CF			28724	R598	220k	CF			21823
R544	270	CF			28720	R599	47	CF			28714
R545	270	CF			28720	R600					
R546	47	CF			28714	R601	390k	MF			38656
R547	2k2	CF			21802	R602	100	CF			21794
R548	56	CF			28715	R603	390	MF			38584

Component List and Illustrations

Section 6

OS3600 TRIGGER (Cont)

Ref	Value	Description	Tol %±	Part No	Ref	Value	Description	Tol %±	Part No
RESISTORS (Cont)					RESISTORS (Cont)				
R604	220	CF		21796	R658	100	CF		21794
R605	560	CF		21798	R659				
R606	390	MF		38584	R660	43k	MF		38633
R607	3k3	CF		21803	R661	300k	MF		38653
R608	3k3	CF		21803	R662	39	CF		28713
R609	20k	PCP		39235	R663				
R610	5k6	CF		21806	R664	3k3	CF		21803
R611	4k7	CF		21805	R665	3k3	CF		21803
R612	22k	CP	"B" Trig Level (With S516)	38677	R671	39	CF		28713
R613	100	CF		21794	R672	300k	MF		38653
R614	47	CF		28714	R673	43k	MF		38633
R615	47	CF		28714	R674	300k	MF		38653
R616	1k	CF		21799	R675	360k	MF		38655
R617	62	MF		38565	R676	360k	MF		38655
R618	330	CF		28721	R677	300k	MF		38653
R619	180	MF		38576	CAPACITORS				
R620	180	MF		38576	C501	.01μF	CE(1)	250V	22395
R621	820	CF		28724	C502	.01μF	CE(1)	250V	22395
R622	100	CF		21794	C503	.01μF	CE(1)	250V	22395
R623	100	CF		21794	C504	.01μF	CE(1)	250V	22395
R624	10	CF		21793	C505	.01μF	CE(1)	250V	22395
R625	22	CF		28710	C506	82pF	PS	A.O.T. 63V	37685
R626	22	CF		28710	C507	.01μF	CE(1)	250V	22395
R627	270	CF		28720	C508	10pF	CE(2)		22364
R628	270	CF		28720	C509	15pF	CE(2)		22366
R629	39	CF		28713	C510	220pF	CE(2)		22379
R630	39	CF		28713	C511	.01μF	CE(1)	250V	22395
R631	680	CF		28723	C512	1000pF	CE(2)		22387
R632	22	CF		28710	C513	.01μF	CE(1)	250V	22395
R633	22	CF		28710	C514	82pF	CE(2)		22375
R634	270	CF		28720	C515	.01μF	CE(1)	250V	22395
R635	27	CF		28711	C516	33pF	CE(2)		22370
R636	27	CF		28711	C517	.01μF	CE(2)	250V	22395
R637	270	CF		28720	C518	39pF	CE(2)		22371
R638	1k	CF		21799	C519	.01μF	CE(1)	250V	22395
R639	10	CF		21793	C520	.01μF	CE(1)	250V	22395
R640	22	CF		28710	C521	22pF	CE(2)		22368
R641	2k2	CF		21802	C522	15pF	CE(2)		22366
R642	390	CF		28722	C523	.01μF	CE(1)	250V	22395
R643	47	CF		28714	C524	.01μF	CE(1)	250V	22395
R644	330	CF		28721	C525	.01μF	CE(1)	250V	22395
R645	330	CF		28721	C526	.01μF	CE(1)	250V	22395
R646	330	CF		28721	C527	5600pF	CE(1)	500V	22394
R647	300	MF		38581	C528	10μF	E	25V	32180
R648	560	CF		21798	C529	10μF	E	25V	32180
R649	390	MF		38584	C530	.01μF	CE(2)	250V	22395
R650	1k5	MF		38598	C531	.1μF	PE	100V	37018
R651	1k2	MF		38596	C532	.1μF	PE	100V	37018
R652	10	CF		21793	C533	120pF	CE(2)		22377
R653	10	CF		21793	C534	.01μF	CE(1)	250V	22395
R654	330	CF		28721	C535	270pF	CE(2)		22380
R655	47	CF		28714	C536	.01μF	CE(1)	250V	22395
R656	10	CF		21793	C537	.01μF	CE(1)	250V	22395
R657	47k	CP	Hold Off	38674	C538	.01μF	CE(1)	250V	22395

Component List and Illustrations

Section 6

OS3600 TRIGGER (Cont)

Ref	Value	Description	Tol % ±	Part No
CAPACITORS (Cont)				
C539	47pF	CE(2)		22372
C540				
C541	5600pF	CE(1)	500V	22394
C542	100pF	CE(2)		22376
C543	0.1μF	CE(1)	250V	39199
C544	.01μF	CE(1)	250V	22395
C545	15pF	TRIMMER		32059
C546	56pF	CE(2)		22373
C547	15pF	TRIMMER		32059
C548	15pF	CE(2)		22366
C549	15pF	CE(2)		22366
C550	.01μF	CE(1)	250V	22395
C551	.01μF	CE(1)	250V	22395
C552	.01μF	CE(1)	250V	22395
C553	220pF	CE(2)		22379
C554	.01μF	CE(1)	250V	22395
C555	33pF	CE(2)		22370
C556	15pF	CE(2)		22366
C557	.01μF	CE(1)	250V	22395
C558	39pF	CE(2)		22371
C559	.01μF	CE(1)	250V	22395
C560	33pF	CE(2)		22370
C561	.01μF	CE(1)	250V	22395
C562	15pF	TRIMMER		32059
C563	15pF	TRIMMER		32059
C564	56pF	CE(2)		22373
C565	.01μF	CE(1)	250V	22395
C566	22pF	CE(2)		22368
C567	15pF	CE(2)		22366
C568	.01μF	CE(1)	250V	22395
C569	.01μF	CE(1)	250V	22395
C570	.01μF	CE(1)	250V	22395
C571	.01μF	CE(1)	250V	22395
C572	10μF	E	10V	40353
C573				
C574				
C575	100pF	CE(2)		22376
C576	0.1μF	CE(1)	250V	39199
C577	.01μF	CE(1)	250V	22395
C581	15pF	TRIMMER		32059
C582	15pF	CE(2)		22366
C583	6pF	TRIMMER		29421
C584	0.01	CE(1)	250V	22395
C585	22pF	CE(2)		22368
C586	22pF	CE(2)		22368
C587	10pF	CE(2)		22364
C588	15pF	TRIMMER		32059
C589	6pF	TRIMMER		29421

TRANSISTORS

TR501	}	WD392	Dual f.e.t.	A36343
TR502				
TR503	}	AE13	Matched pair	A31254
TR504				

TRANSISTORS (Cont)

TR505		2N3904		24146
TR506		2N3904		24146
TR507		MPSH10		40315
TR508		MPSH10		40315
TR509		BF479		39270
TR510		BF479		39270
TR511		MPSH10		40315
TR512		MPSH10		40315
TR513		MPSH10		40315
TR514		MPSH10		40315
TR515		MPSH10		40315
TR516		2N5771		38089
TR517		MPSH10		40315
TR518		BC182B		33205
TR519				
TR520	}	WD392	Dual f.e.t.	A36243
TR521				
TR522		AE13	Matched pair	A31254
TR523				
TR524		MPSH10		40315
TR525		MPSH10		40315
TR526		BF479		39270
TR527		BF479		39270
TR528		MPSH10		40315
TR529		MPSH10		40315

DIODES

D15		L.E.D.		39884
D501	5V1	ZENER		33923
D502		IN4148		23802
D503	3V3	ZENER		33923
D504	9V1	ZENER		33934
D505	6V2	ZENER		33930
D506		IN4148		23802
D507		IN4148		23802
D508		IN4149		1949
D509		IN4149		1949
D510		IN4148		23802
D511		IN4148		23802
D512		IN3595		29330
D513		IN3595		29330
D514		IN4148		23802
D515	9V1	ZENER		33934

INTEGRATED CIRCUITS

IC501		10216		33903
IC502		10216		33903

MISCELLANEOUS

S501-504	Switch Push Button	
	A Coupling	A3/40738
S505-507	Switch Push Button	
	B Coupling	A3/40737
S508-512	Switch A Trigger Source	A3/41672
S513-515	Switch B Trigger Source	A3/42268

OS3600 TRIGGER (Cont)

<i>Ref</i>	<i>Value</i>	<i>Description</i>	<i>Tol % ±</i>	<i>Part No</i>	<i>Ref</i>	<i>Value</i>	<i>Description</i>	<i>Tol % ±</i>	<i>Part No</i>
MISCELLANEOUS (Cont)									
S516		Switch Select B Gated Part of R612		38677	PLR		Plug Molex 3-Way LKG		39222
					SKCC		Socket BNC Ext. X A Input		1222
PLP		Plug Molex 14-Way		38297	SKDD		Socket BNC Ext X B Input		1222

EXT
TO

CH 2

CH 1

COMP
TRIG

SWCC
EXT X A
INPUT

R25 R26 R27 R28 R29 R30 R31 R32 R33 R34 R35 R36 R37 R38 R39 R40 R41 R42 R43 R44 R45 R46 R47 R48 R49 R50 R51 R52 R53 R54 R55 R56 R57 R58 R59 R60 R61 R62 R63 R64 R65 R66 R67 R68 R69 R70 R71 R72 R73 R74 R75 R76 R77 R78 R79 R80 R81 R82 R83 R84 R85 R86 R87 R88 R89 R90 R91 R92 R93 R94 R95 R96 R97 R98 R99 R100 R101 R102 R103 R104 R105 R106 R107 R108 R109 R110 R111 R112 R113 R114 R115 R116 R117 R118 R119 R120 R121 R122 R123 R124 R125 R126 R127 R128 R129 R130 R131 R132 R133 R134 R135 R136 R137 R138 R139 R140 R141 R142 R143 R144 R145 R146 R147 R148 R149 R150 R151 R152 R153 R154 R155 R156 R157 R158 R159 R160 R161 R162 R163 R164 R165 R166 R167 R168 R169 R170 R171 R172 R173 R174 R175 R176 R177 R178 R179 R180 R181 R182 R183 R184 R185 R186 R187 R188 R189 R190 R191 R192 R193 R194 R195 R196 R197 R198 R199 R200 R201 R202 R203 R204 R205 R206 R207 R208 R209 R210 R211 R212 R213 R214 R215 R216 R217 R218 R219 R220 R221 R222 R223 R224 R225 R226 R227 R228 R229 R230 R231 R232 R233 R234 R235 R236 R237 R238 R239 R240 R241 R242 R243 R244 R245 R246 R247 R248 R249 R250 R251 R252 R253 R254 R255 R256 R257 R258 R259 R260 R261 R262 R263 R264 R265 R266 R267 R268 R269 R270 R271 R272 R273 R274 R275 R276 R277 R278 R279 R280 R281 R282 R283 R284 R285 R286 R287 R288 R289 R290 R291 R292 R293 R294 R295 R296 R297 R298 R299 R300 R301 R302 R303 R304 R305 R306 R307 R308 R309 R310 R311 R312 R313 R314 R315 R316 R317 R318 R319 R320 R321 R322 R323 R324 R325 R326 R327 R328 R329 R330 R331 R332 R333 R334 R335 R336 R337 R338 R339 R340 R341 R342 R343 R344 R345 R346 R347 R348 R349 R350 R351 R352 R353 R354 R355 R356 R357 R358 R359 R360 R361 R362 R363 R364 R365 R366 R367 R368 R369 R370 R371 R372 R373 R374 R375 R376 R377 R378 R379 R380 R381 R382 R383 R384 R385 R386 R387 R388 R389 R390 R391 R392 R393 R394 R395 R396 R397 R398 R399 R400 R401 R402 R403 R404 R405 R406 R407 R408 R409 R410 R411 R412 R413 R414 R415 R416 R417 R418 R419 R420 R421 R422 R423 R424 R425 R426 R427 R428 R429 R430 R431 R432 R433 R434 R435 R436 R437 R438 R439 R440 R441 R442 R443 R444 R445 R446 R447 R448 R449 R450 R451 R452 R453 R454 R455 R456 R457 R458 R459 R460 R461 R462 R463 R464 R465 R466 R467 R468 R469 R470 R471 R472 R473 R474 R475 R476 R477 R478 R479 R480 R481 R482 R483 R484 R485 R486 R487 R488 R489 R490 R491 R492 R493 R494 R495 R496 R497 R498 R499 R500 R501 R502 R503 R504 R505 R506 R507 R508 R509 R510 R511 R512 R513 R514 R515 R516 R517 R518 R519 R520 R521 R522 R523 R524 R525 R526 R527 R528 R529 R530 R531 R532 R533 R534 R535 R536 R537 R538 R539 R540 R541 R542 R543 R544 R545 R546 R547 R548 R549 R550 R551 R552 R553 R554 R555 R556 R557 R558 R559 R560 R561 R562 R563 R564 R565 R566 R567 R568 R569 R570 R571 R572 R573 R574 R575 R576 R577 R578 R579 R580 R581 R582 R583 R584 R585 R586 R587 R588 R589 R590 R591 R592 R593 R594 R595 R596 R597 R598 R599 R600 R601 R602 R603 R604 R605 R606 R607 R608 R609 R610 R611 R612 R613 R614 R615 R616 R617 R618 R619 R620 R621 R622 R623 R624 R625 R626 R627 R628 R629 R630 R631 R632 R633 R634 R635 R636 R637 R638 R639 R640 R641 R642 R643 R644 R645 R646 R647 R648 R649 R650 R651 R652 R653 R654 R655 R656 R657 R658 R659 R660 R661 R662 R663 R664 R665 R666 R667 R668 R669 R670 R671 R672 R673 R674 R675 R676 R677 R678 R679 R680 R681 R682 R683 R684 R685 R686 R687 R688 R689 R690 R691 R692 R693 R694 R695 R696 R697 R698 R699 R700 R701 R702 R703 R704 R705 R706 R707 R708 R709 R710 R711 R712 R713 R714 R715 R716 R717 R718 R719 R720 R721 R722 R723 R724 R725 R726 R727 R728 R729 R730 R731 R732 R733 R734 R735 R736 R737 R738 R739 R740 R741 R742 R743 R744 R745 R746 R747 R748 R749 R750 R751 R752 R753 R754 R755 R756 R757 R758 R759 R760 R761 R762 R763 R764 R765 R766 R767 R768 R769 R770 R771 R772 R773 R774 R775 R776 R777 R778 R779 R780 R781 R782 R783 R784 R785 R786 R787 R788 R789 R790 R791 R792 R793 R794 R795 R796 R797 R798 R799 R800 R801 R802 R803 R804 R805 R806 R807 R808 R809 R810 R811 R812 R813 R814 R815 R816 R817 R818 R819 R820 R821 R822 R823 R824 R825 R826 R827 R828 R829 R830 R831 R832 R833 R834 R835 R836 R837 R838 R839 R840 R841 R842 R843 R844 R845 R846 R847 R848 R849 R850 R851 R852 R853 R854 R855 R856 R857 R858 R859 R860 R861 R862 R863 R864 R865 R866 R867 R868 R869 R870 R871 R872 R873 R874 R875 R876 R877 R878 R879 R880 R881 R882 R883 R884 R885 R886 R887 R888 R889 R890 R891 R892 R893 R894 R895 R896 R897 R898 R899 R900 R901 R902 R903 R904 R905 R906 R907 R908 R909 R910 R911 R912 R913 R914 R915 R916 R917 R918 R919 R920 R921 R922 R923 R924 R925 R926 R927 R928 R929 R930 R931 R932 R933 R934 R935 R936 R937 R938 R939 R940 R941 R942 R943 R944 R945 R946 R947 R948 R949 R950 R951 R952 R953 R954 R955 R956 R957 R958 R959 R960 R961 R962 R963 R964 R965 R966 R967 R968 R969 R970 R971 R972 R973 R974 R975 R976 R977 R978 R979 R980 R981 R982 R983 R984 R985 R986 R987 R988 R989 R990 R991 R992 R993 R994 R995

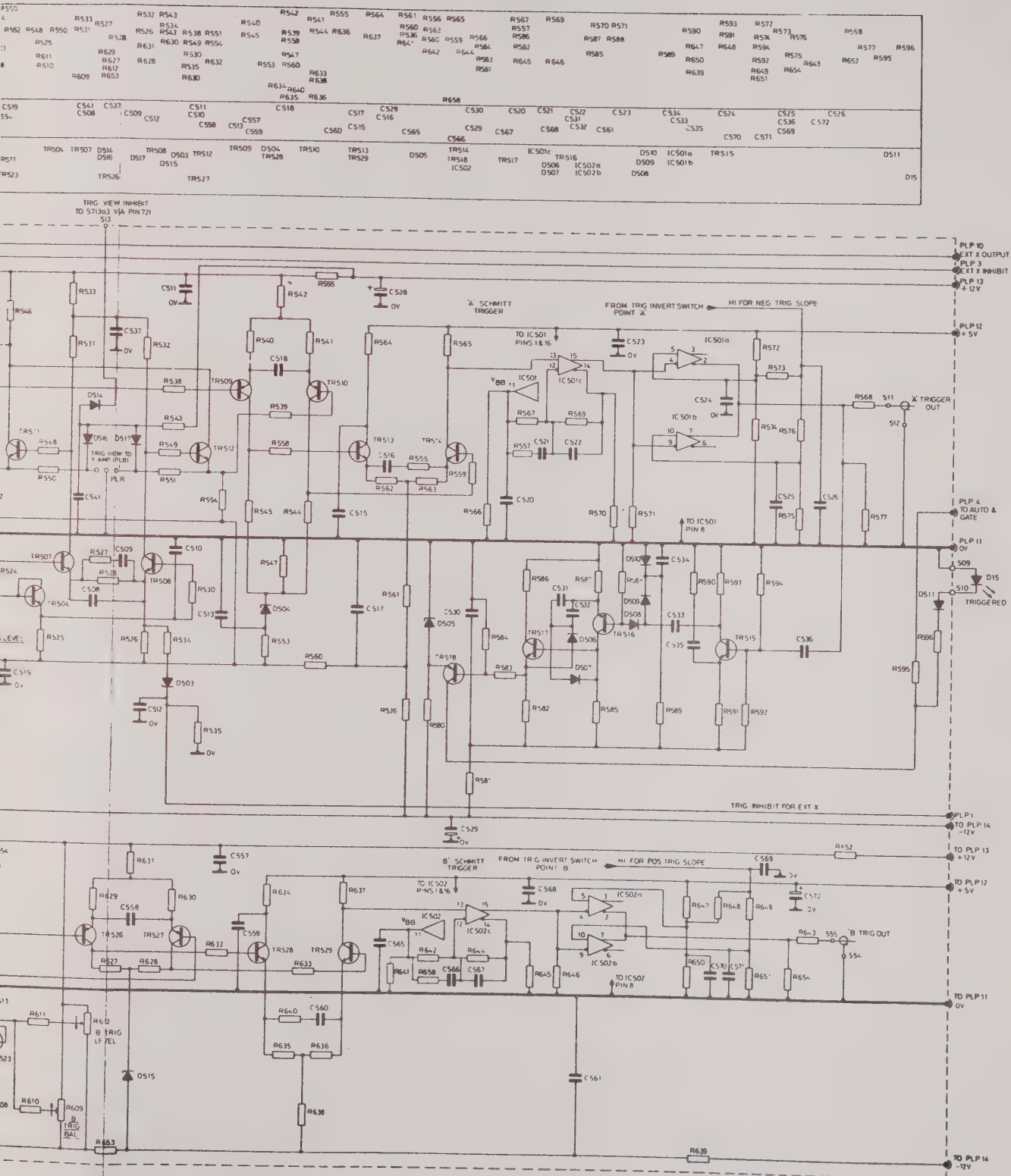


Fig. 6 Trigger Circuit Diagram

Component List and Illustrations

Section 6

OS3600 TIMEBASE, 'X' O/P & CALIBRATOR

Ref	Value	Description	Tol % ±	Part No	Ref	Value	Description	Tol % ±	Part No
RESISTORS					RESISTORS (Cont)				
R701	10k	CF		21809	R756	12k	CF		21810
R702	2k2	CF		21802	R757	33k	CF		21814
R703	180	CF		21795	R758	470k	CF		32330
R704					R759	470k	CF		32330
R705					R760	22k	CF		21812
R706					R761	5k	PCP		39234
R707	2k2	CF		21802	R762	10k	CF		21809
R708	4k7	CF		21805	R763	56	CF		28715
R709	270	CF		28720	R764	68k	CF		21816
R710	1k2	MF		38596	R765	18k	MF		38624
R711	470	CF		21797	R766	9k1	MF		38617
R712	3k3	MF		38606	R767	50k	PCP		39268
R713	3k9	CF		21804	R768	5k6	CF		21806
R714	100	CF		21794	R769	39k	CF		28728
R715	2k2	CF		21802	R770	2k7	CF		28726
R716	1k5	CF		21801	R771	910	MF		38593
R717					R772	2k7	CF		28726
R718					R773	390	CF		28722
R719	2k7	CF		28726	R774	47	CF		28714
R720	390	CF		28722	R775	47	CF		28714
R721	1k	CF		21799	R776	47	CF		28714
R722	680	CF		28723	R777	15	CF		28708
R723	680	CF		28723	R778	10k	CF		21809
R724	1k	CF		21799	R779	1k2	CF		21800
R725	1k2	CF		21800	R780	39k	CF		28728
R726	360	MF		38583	R781	33k	CF		21814
R727	1k5	CF		21801	R782	390	CF		28722
R728	3k3	CF		21803	R783	3k9	CF		21804
R729	220	CF		21796	R784	1k	CF		21799
R730	10	CF		21793	R785	470	CF		21797
R731	100	CF		21794	R786	680	CF		28723
R732	10	CF		21793	R787	2k7	CF		28726
R733	820	MF		38592	R788	8k2	CF		21808
R734	1k5	CF		21801	R789	1k	CF		21799
R735	6k8	CF		21807	R790	2k2	CF		21802
R736	470	CF		21797	R791	3k9	CF		21804
R737	150k	MF		38646	R792	470	CF		21797
R738	10k	CF		21809	R793	220	CF		21796
R739	3k3	CF		21803	R794	39	CF		28713
R740	1k5	CF		21801	R795	470	CF		21797
R741	270k	CF		32356	R796	10k	CF		21809
R742	8k2	CF		21808	R797				
R743	10k	CF		21809	R798	15	CF		28708
R744	10k	CF		21809	R799	1k	CF		21799
R745	220k	MF		38650	R800	1k	CF		21799
R746	15k	CF		28727	R801	390	CF		28722
R747	15k	CF		28727	R802	360	MF		38583
R748	470	CF		21797	R803	6k8	CF		21807
R749	510	MF		38587	R804	820	MF		38592
R750	10	CF		21793	R805	10	CF		21793
R751	560	CF		21798	R806	2k7	CF		28726
R752	220	CF		21796	R807	10	CF		21793
R753	1k5	CF		21801	R808	1k8	CF		28725
R754	1k5	CF		21801	R809	510	MF		38587
R755	8k2	CF		21808	R810	560	CF		21798

Component List and Illustrations

Section 6

OS3600 TIMEBASE, 'X' O/P & CALIBRATOR (Cont)

Ref	Value	Description	Tol %±	Part No	Ref	Value	Description	Tol %±	Part No
RESISTORS (Cont)					RESISTORS (Cont)				
R811	15k	CF		28727	R872	6k8	CF		21807
R812	1k5	CF		21801	R873	4k7	CF		21805
R813	10k	CF		21809	R874	12k	CF		21810
R814	8k2	CF		21808					
R815	22k	CF		21812	R880	6k8	CF		21807
R816	5k	PCP		39234	R881	120	CF		28718
R817	8k2	CF		21808	R882	100	CF		21794
R818	15k	CF		28727	R883	12k	CF		21810
R819	220	CF		21796	R884	12k	CF		21810
R820	4R7	CF		29433	R885	100	CF		21794
R821	12k	CF		21810	R886	5k6	CF		21806
R822	470k	CF		32330	R887	47k	CF		21815
R823	470k	CF		32330	R888	47k	CF		21815
R824	33k	CF		21814	R889				
R825	3k3	CF		21803	R890	3k9	CF		21804
R826	470	CF		21797	R891	470	CF		21797
R827	430	MF		38585	R892				
R828	100	CF		21794	R893	3k3	CF		21803
R829	56	CF		28715	R894	390	CF		28722
R830	68k	CF		21816	R895	390	CF		28722
R831	39k	CF		28728	R896	560	CF		21798
R832	9k1	MF		38617	R897	47	CF		28714
R833	50k	PCP		39268	R898	47	CF		28714
R834	18k	MF		38624	R899	47k	CF		21815
R835	5k6	CF		21806	R900	10	CF		21793
R836	1k2	CF		21800	R901	4k7	CF		21805
R837	47	CF		28714	R902	1k	CF		21799
R838	1k5	CF		21801	R903	4k7	CF		21805
R839	39k	CF		28728	R904	4k7	CF		21805
R840					R905	4k7	CF		21805
R841	5k6	CF		21806	R906	10	CF		21793
R842	10k	CF		21809	R907	6k8	CF		21807
					R908	6k8	CF		21807
R850	10k	PCP		39265	R909	56k	CF		28729
R851	4k3	MF		38609	R910	4k7	CF		21805
R852	5k6	CF		21806	R911	2k2	CF		21802
R853	3k9	CF		21804	R912	10k	CF		21809
R854	2k2	CF		21802	R913	100	CF		21794
R855	10k	CF		21809	R914	100	CF		21794
R856	2k2	CF		21802	R915	1k	PCP		39233
R857	2k2	CF		21802	R916	680	CF		28723
R858	2k2	CF		21802	R917	100	CF		21794
R859	1k5	CF		21801	R918				
R860	1k5	CF		21801	R919	4k7	CF		21805
R861	4k7	CF		21805	R920	3k3	CF		21803
R862	4k7	CF		21805	R921	1k	CF		21799
R863	4k7	CF		21805	R922				
R864	4k7	CF		21805					
R865	6k8	CF		21807	R928	270	CF		28720
R866	6k8	CF		21807	R929	22	CF		28710
R867	4k7	CF		21805	R930	1k	CF		21799
R868	6k8	CF		21807	R931	620	MF		38589
R869	4k7	CF		21805	R932	47	CF		28714
R870	6k8	CF		21807	R933	220	CF		21796
R871	6k8	CF		21807	R934	220	CF		21796

Component List and Illustrations

Section 6

OS3600 TIMEBASE, 'X' O/P & CALIBRATOR (Cont)

Ref	Value	Description	Tol %±	Part No	Ref	Value	Description	Tol %±	Part No
RESISTORS (Cont)					CAPACITORS				
R935	150k	MF		38646	C701	1000pF	CE(2)		22387
R936	150k	MF		38646	C702	.01μF	CE(1)	250V	22395
R937	36k	MO		28811	C703	10μF	E	10V	40353
R938	36k	MO		28811	C704	.01μF	CE(1)	250V	22395
R939	68	CF		28716	C705	.01μF	CE(1)	250V	22395
R940	680	CF		28723	C706	33pF	CE(2)		22370
R941	330	CF		28721	C707	0.01μF	CE(1)	250V	22395
R942	560	CF		21798	C708	.01μF	CE(1)	250V	22395
R943	68	CF		28716	C709	1μF	T	35V	34895
R944	36k	MO		28811	C710	47pF	CE(2)		22372
R945	10	CF		21793	C711	.01μF	CE(1)	250V	22395
R946	470	CF		21797	C712	1μF	PE	100V	37389
R947	47	CF		28714	C713	.01μF	PE	100V	39190
R948	6k8	CF		21807	C714	10μF	E	10V	40353
R949	6k8	CF		21807	C715	220pF	CE(2)		22379
R950	10	CF		21793	C716	56pF	CE(2)		22373
R951	33k	MF		38630	C717	.1μF	PE	100V	37018
R952	51k	MF		38635	C718	68pF	CE(2)		22374
R953	22	CF		28710	C719	2.2μF	PC		40853
R954	10k	MF		38618	C720	.022μF	PC		40854
R955	10k	MF		38618	C721	180pF	SM	½pF	4515
R956	470	CF		21797	C722	45pF	FT		36274
R957	1k	PCP		39233	C723	.01μF	CE(1)	250V	22395
R958	220	CF		21796	C724	10μF	E	25V	32180
R959	220	CF		21796	C725				
R960	10k	PCP		39265	C726	.01μF	CE(1)	250V	22395
R961	5k6	CF		21806	C727				
R962	2k2	MF		38602	C728	.01μF	CE(1)	250V	22395
R963	2k2	MF		38602	C729	.01μF	CE(1)	250V	22395
R964	4k7	CF		21805	C730	.01μF	CE(1)	250V	22395
R965	2k2	CF		21802	C731	.01μF	CE(1)	250V	22395
R966	56k	CF		28729	C732	.01μF	CE(1)	250V	22395
R967	5k6	CF		21806	C733	.01μF	CE(1)	250V	22395
R968	36k	MF		38631	C734	.01μF	CE(1)	250V	22395
R969	1k6	MF		38599	C735	68pF	CE(2)		22374
R970	12k	MF		38620	C736	.01μF	CE(1)	250V	22395
R971	10k	CF	A.O.T.	21809	C737	.01μF	CE(1)	250V	22395
R972	4k7	CF	A.O.T.	21805	C738	.01μF	CE(1)	250V	22395
R973	750	MF		38591	C739	56pF	CE(2)		22373
R974	5k6	MF		38612	C740	180pF	SM	½pF	4515
R975	11k	MF		38619	C741	45pF	FT		36274
R976	30k	MF		38629	C742	2.2μF	PC		40853
R977	10	CF		21793	C743	10μF	E	10V	40353
R978	3k9	CF		21804	C744	10μF	E	25V	32180
R979	22	CF		28710	C745	.01μF	CE(1)	250V	22395
R980	220	CF		21796	C746	.022μF	PC		40854
R981	220	CF		21796	C747	220pF	CE(2)		22379
R982	680	CF		28723	C748	.01μF	CE(1)	250V	22395
R983	9k1	MF		38617	C749	56pF	CE(2)		22373
R984	3k3	CF		21803	C750	.01μF	CE(1)	250V	22395
R985	10k1	MF	0.5 1/8W	37778	C751	10μF	E	25V	32180
R986					C752	.01μF	CE(1)	250V	22395
R987	1k3	MF		38597	C753	.1μF	PE	100V	37018
R988	100	CF		21794	C754				
R989	100	CF		21794	C755				
R990	10k	CF		21809	C756	10μF	E	10V	40353

Component List and Illustrations

Section 6

OS3600 TIMEBASE, 'X' O/P & CALIBRATOR (Cont)

Ref	Value	Description	Tol %±	Part No	Ref	Value	Description	Tol %±	Part No
TRANSISTORS (Cont)					DIODES (Cont)				
TR810		BF371		36275	D749		IN4148		23802
TR811		BF371		36275	D750		IN4148		23802
TR812		BF371		36275	D751		IN4148		23802
TR813		2N3904		24146	D752				
TR814		2N3904		24146	D753		IN4148		23802
TR815		2N3904		24146	D754		IN4148		23802
DIODES					D801	5V6	ZENER		33929
D701		IN4148		23802	D802	3V9	ZENER		33925
D702		IN4148		23802	D803	7V5	ZENER		33932
D703		IN4148		23802	D804		IN4149		1949
D704		IN4148		23802	D805		IN4149		1949
D705		IN4148		23802	D806		IN4149		1949
D706		IN4148		23802	D807		IN4149		1949
D707		IN4148		23802	D808		FH1100		40352
D708		IN4148		23802	D809		FH1100		40352
D709		IN4148		23802	D810		IN4149		1949
D710		IN4148		23802	D811		IN4149		1949
D711		IN4148		23802	D812		IN4148		23802
D712	3V9	ZENER		33925	D813		IN4148		23802
D713		IN4148		23802	D814	5V1	ZENER		33928
D714		IN4148		23802	D815	33V	ZENER		33947
D715		IN4148		23802	D816	33V	ZENER		33947
D716		IN4148		23802					
D717		IN4148		23802	D821		IN4148		23802
D718		IN4148		23802	D822		IN4148		23802
D719		IN4148		23802	INTEGRATED CIRCUITS				
D720	2V7	ZENER		33921	IC701		10231		39247
D721		IN4148		23802	IC702		10103		40346
D722		IN4148		23802	IC703		10102		30243
D723		IN4148		23802	IC704		10231		39247
D724		IN4148		23802	IC705		74LS112		36468
D725		IN4148		23802	IC706		741		36736
D726		IN4148		23802	IC707		74L10		32698
D727		IN4148		23802	IC708		74LS112		36468
D728		IN4148		23802	IC709		CD4066		40345
D729		IN4148		23802	IC710		1414		35682
D730		IN4148		23802	IC711		CA3086		42907
D731	3V9	ZENER		33925	IC712		CA3086		42907
D732		IN4148		23802	IC713		CA3086		42907
D733		IN4148		23802	IC714		709		40179
D734		IN4148		23802	MISCELLANEOUS				
D735		IN4148		23802	S701-705		Switch Pushbutton		A3/40735
D736		IN4148		23802	S706-708		Switch Pushbutton		A3/40736
D737		IN4148		23802	S709-713		Switch Pushbutton		
D738		IN4148		23802			Y Mode Select		A3/43001
D739		IN4148		23802	L701		Ferrite Bead FX1242		26986
D740	5V6	ZENER		33929	L702		Ferrite Bead FX1242		26986
D741		IN4148		23802	PLS		Plug Molex 14 Way		38297
D742		IN4148		23802	PLT		Plug Molex 19 Way		42502
D743					PLU		Plug Molex 11 Way		40323
D744		IN4148		23802	PLV		Plug Molex 13 Way		39387
D745		IN4148		23802	PLW		Plug Molex 9 Way		39386
D746		IN4148		23802	PLX		Plug Molex 13 Way		39287
D747		IN4148		23802					
D748		IN4148		23802					

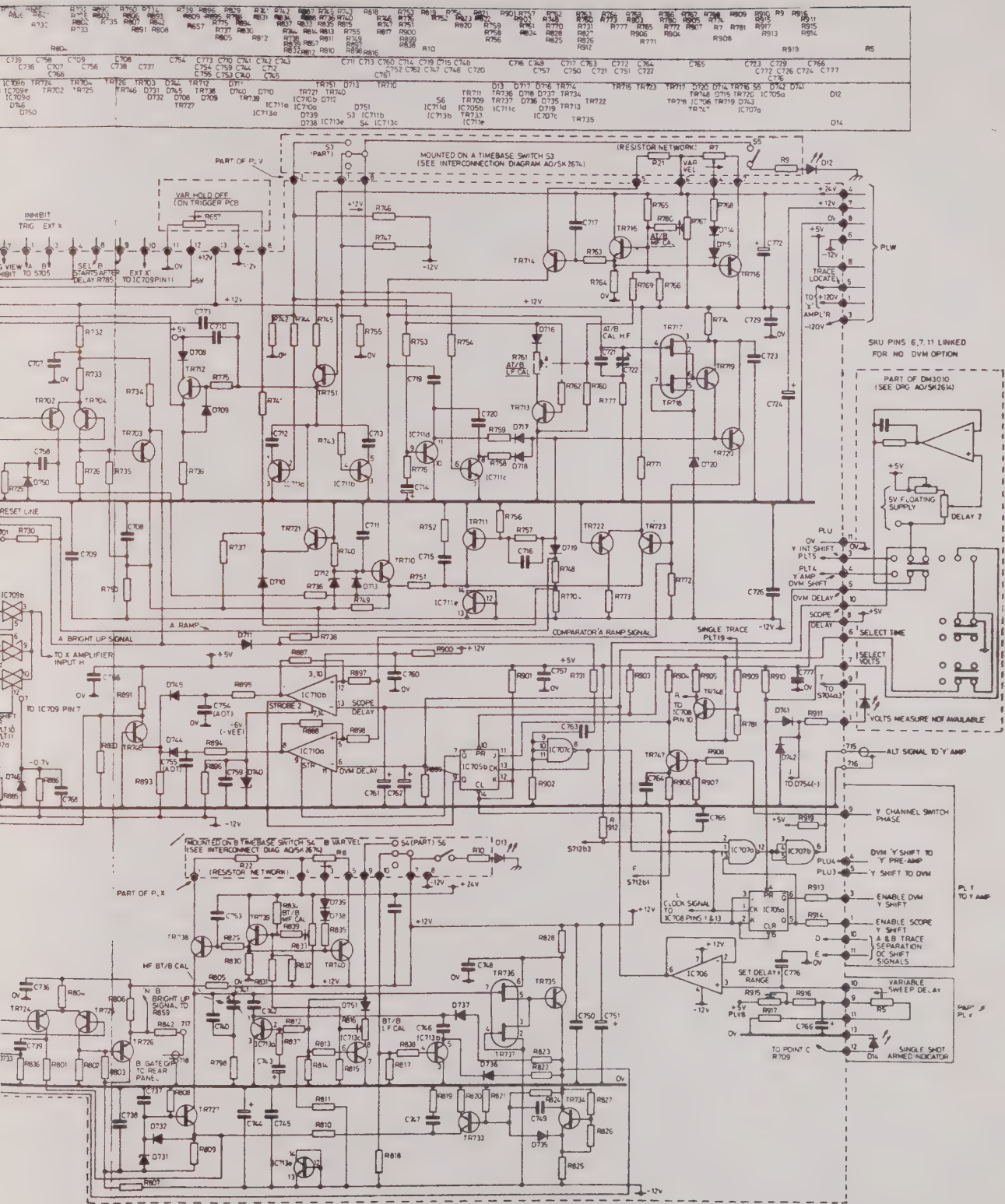
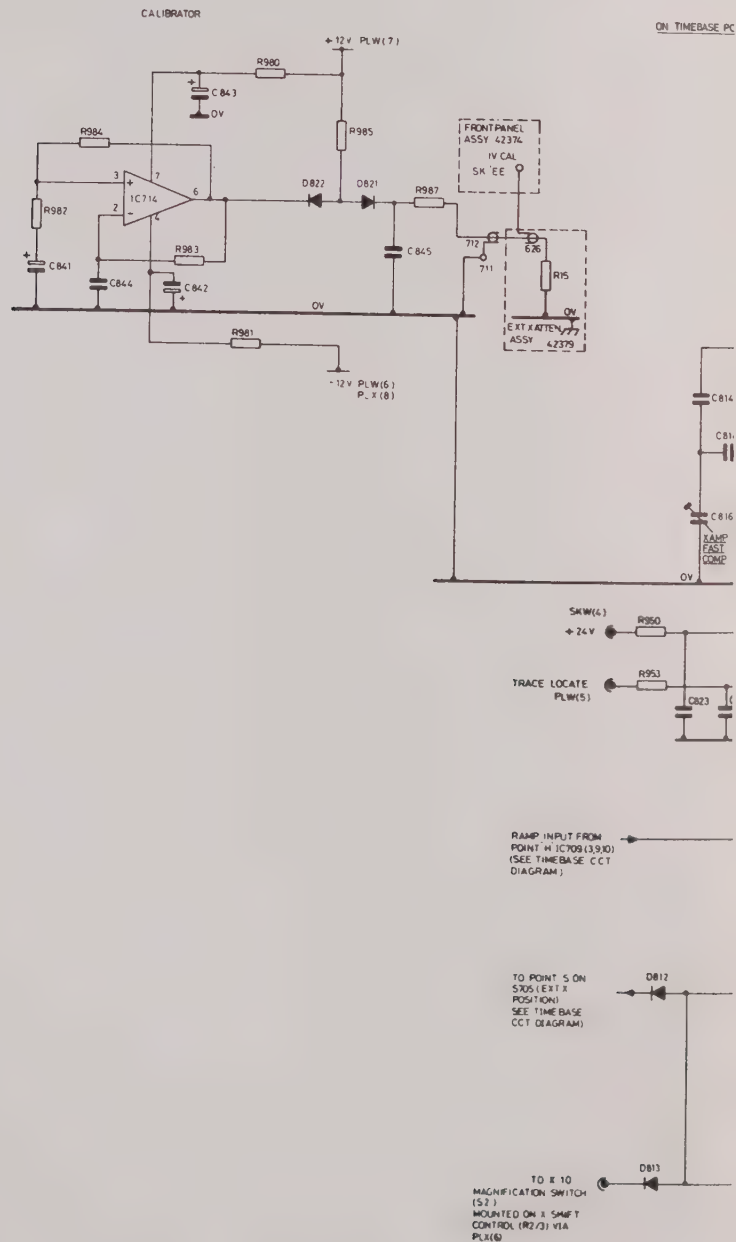


Fig. 7A Timebase 'X' O/P & Calibrator Circuit Diagram

	R982	R984	R983	R980	R985	R987	R15	R950 R953
RESIS								
CAP	C841	C844	C843	C842		C845		C814 C823 C816
MISC			IC714		D822	D821		D812 D813
							SKEE	



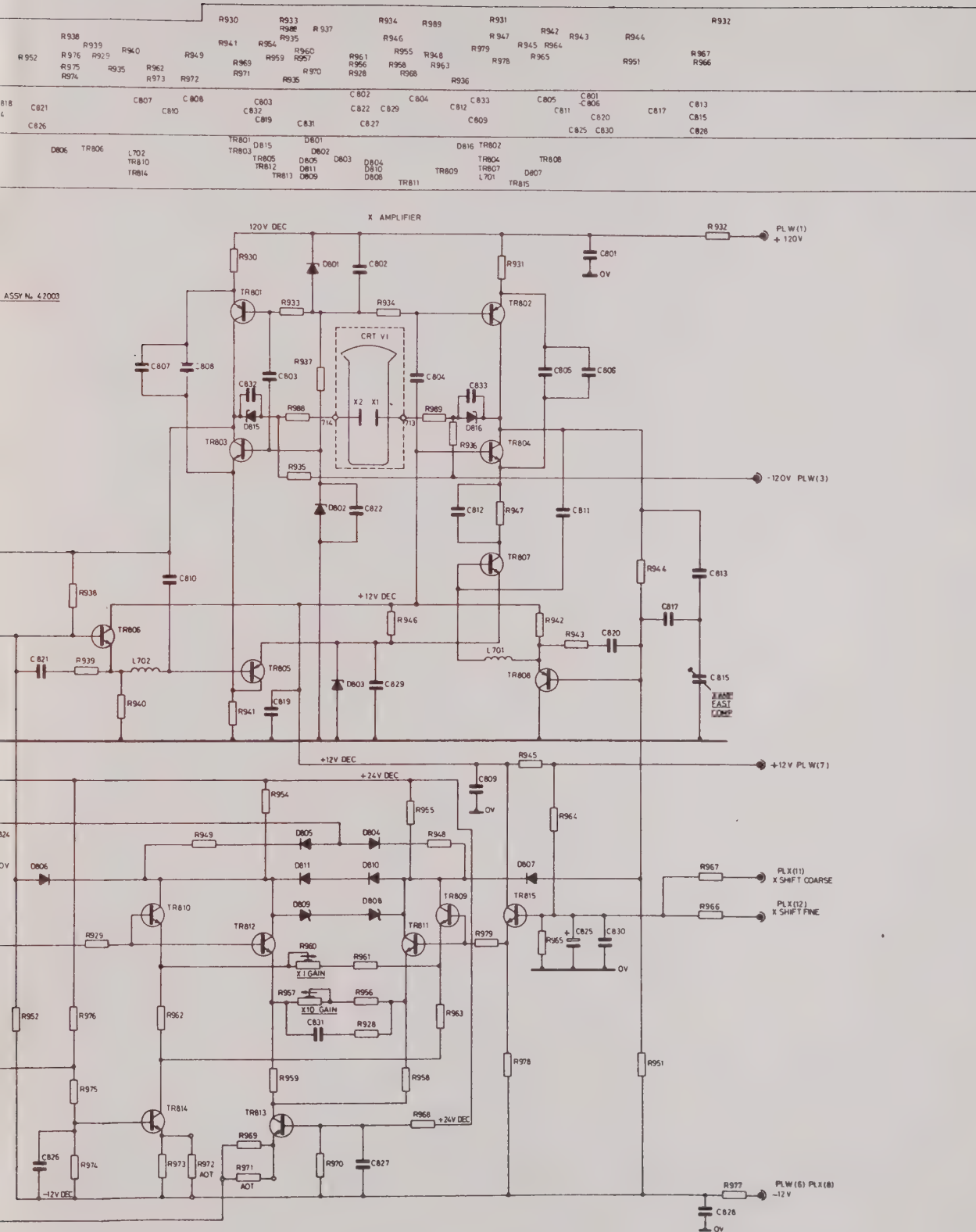


Fig. 7B Timebase, 'X' O/P & Calibrator Circuit Diagram

Component List and Illustrations

Section 6

OS3600 'Y' PRE-AMP BEAM SWITCH 'Y' DRIVER & O/P

Ref	Value	Description	Tol %±	Part No	Ref	Value	Description	Tol %±	Part No
RESISTORS									
R11	4k7	CP Pot Y Shift		A4/42203	R101	22	CF		28710
R12	4k7	CP Pot Y Shift		A4/42203	R102	10	CF		21793
R13	2k2	CP Log. (+S7)Fine Gain		A4/42993	R103	2k2	CF		21802
R14	2k2	CP Log. (+S8)Fine Gain		A4/42993	R104	47	CF	1/8W	43146
R27	47	CF		28714	R105	47	CF	1/8W	43146
R28	100	CF		21794	R106	82	CF	1/8W	43149
R43	56	CF		28715	R107	1k	CF		21799
R44	56	CF		28715	R108	2k2	CF		21802
R45	47	CF		28714	R109	22k	CF		21812
R46	47	CF		28714	R110	100	CF		21794
R47	10	CF		21793	R111	47	CF	1/8W	43146
R48	10	CF		21793	R112	10	CF		21793
R49	10	CF		21793	R113	820	CF		28724
R50	10	CF		21793	R114	47	CF	1/8W	43146
R51	10	CF		21793	R115	10k	CF		21809
R52	10	CF		21793	R116	1k2	CF		21800
R53	18	CF		28709	R117	10	CF		21793
R54	18	CF		28709	R118	470	CF		21797
R55	10k	CF		21809	R119	150	MF		38574
R56	10k	CF		21809	R120	2k	MF		38601
					R121	2k	MF		38601
					R122	10	CF		21793
R59	33	CF		28712	R123	220	CF	1/8W	43359
R60	33	CF		28712	R124	820	MF		38592
R61	39	CF		28713	R125	820	MF		38592
R62	39	CF		28713	R126	1k8	CF		28725
R63	33	CF		28712	R127	100	CF	1/8W	43150
R64	33	CF		28712	R128	100	CF	1/8W	43150
					R129	470	CF		21797
R71	900k	MF	0.5	31929	R130	100	CF		21794
R72	900k	MF	0.5	31929	R131	100	CF		21794
R73	111k	MF	0.5	31930	R132	1k5	CF		21801
R74	111k	MF	0.5	31930	R133	390	CF		28722
R75	990k	MF	0.5	31927	R134	not used			
R76	990k	MF	0.5	31927	R135	10	CF		21793
R77	10k1	MF	0.5	37778	R136	1k2	MF		38596
R78	10k1	MF	0.5	37778	R137	1k2	MF		38596
R79	100k	MF		38642	R138	47	CF	1/8W	43146
R80	100k	MF		38642	R139	47	CF	1/8W	43146
R81	1k2	CF		21800	R140	3k6	MF		38607
R82	1k2	CF		21800	R141	22k	CF		21812
R83		Resistor Network		A3/43135	R142	470	CF		21797
R84		Resistor Network		A3/43136	R143	100	CF		21794
R85	900k	MF	0.5	31929	R144	100	CF		21794
R86	900k	MF	0.5	31929	R145	100	CF	1/8W	43150
R87	270	MF		38580	R146	100	CF	1/8W	43150
R88	270	MF		38580	R147	22	CF		28710
R89	270	MF		38580	R148	270	MF		38580
R90	270	MF		38580	R149	270	MF		38580
R91	470k	CC		4906	R150	560	MF		38588
R92	470k	CC		4906	R151	560	MF		38588
R93	470k	CC		4906	R152	470	MF	1	43622
R94	470k	CC		4906	R153	470	MF	1	43622
R95	75	MF		38567	R154	470	CF		21797
R96	75	MF		38567	R155	68	MF		38566

Component List and Illustrations

Section 6

OS3600 'Y' PRE-AMP BEAM SWITCH, 'Y' DRIVER & O/P (Cont)

Ref	Value	Description	Tol %±	Part No	Ref	Value	Description	Tol %±	Part No
RESISTORS (Cont)									
R156	1k2	CF		21800	R211	47	CF	1/8W	43146
R157	1k2	CF		21800	R212	not used			
R158	3k	MF		38605	R213	820	CF		28724
R159	3k	MF		38605	R214	47	CF	1/8W	43146
R160	10	CF		21793	R215	10k	CF		21809
R161	51	MF		38563	R216	1k2	CF		21800
R162	10	CF		21793	R217	10	CF		21793
R163	47	CF		28714	R218	470	CF		21797
R164	330	CF		28721	R219	150	MF		38574
R165	330	CF		28721	R220	2k	MF		38601
R166	100	MF		38570	R221	2k	MF		38601
R167	100	MF		38570	R222	10	CF		21793
R168	620	MF		38589	R223	220	CF	1/8W	43359
R169	4k7	CF		21805	R224	820	MF		38592
R170	27	CF		28711	R225	820	MF		38592
R171	470	CF		21797	R226	1k8	CF		28725
R172	2k7	MF		38604	R227	100	CF	1/8W	43150
R173	2k7	CF		28726	R228	100	CF	1/8W	43150
R174	5k6	CF		21806	R229	470	CF		21797
R175	5k6	CF		21806	R230	100	CF		21794
R176	3k9	CF		21804	R231	100	CF		21794
R177	3k9	CF		21804	R232	1k5	CF		21801
R178	1k	PCP		39233	R233	390	CF		28722
R179	20k	PCP		39235	R234	not used			
R180	50k	PCP		39268	R235	10	CF		21793
R181	200	PCP		39231	R236	1k2	MF		38596
R182	50	PCP		39267	R237	1k2	MF		38596
R183	100	PCP		39230	R238	47	CF	1/8W	43146
R184	1k	PCP		39233	R239	47	CF	1/8W	43146
R185	1k	PCP		39233	R240	3k6	MF		38607
R186	47	CF		28714	R241	22k	CF		21812
R187	47	CF		28714	R242	470	CF		21797
R188	22	CF	1/8W	43142	R243	100	CF		21794
R189	2k2	CF	1/8W	43357	R244	100	CF		21794
R190	100	CF	1/8W	43150	R245	100	CF	1/8W	43150
R191	3k3	CF	1/8W	43358	R246	100	CF	1/8W	43150
R192	not used				R247	22	CF		28710
R193	1k2	CF		21800	R248	270	MF		38580
R194	47	CF		28714	R249	270	MF		38580
R195	47	CF		28714	R250	560	MF		38588
R196	100	CF		21794	R251	560	MF		38588
R197	270	CF		28720	R252	470	MF	1	43622
R198	33k	CF		21814	R253	470	MF	1	43622
R199	220	CF		21796	R254	470	CF		21797
R200	not used				R255	68	MF		38566
R201	22	CF		28710	R256	1k2	CF		21800
R202	10	CF		21793	R257	1k2	CF		21800
R203	2k2	CF		21802	R258	3k	MF		38605
R204	47	CF	1/8W	43146	R259	3k	MF		38605
R205	47	CF	1/8W	43146	R260	10	CF		21793
R206	82	CF	1/8W	43149	R261	51	MF		38563
R207	1k	CF		21799	R262	10	CF		21793
R208	2k2	CF		21802	R263	47	CF		28714
R209	22k	CF		21812	R264	330	CF		28721
R210	100	CF		21794	R265	330	CF		28721

Component List and Illustrations

Section 6

OS3600 'Y' PRE-AMP BEAM SWITCH, 'Y' DRIVER & O/P (Cont)

Ref	Value	Description	Tol %±	Part No	Ref	Value	Description	Tol %±	Part No
RESISTORS (Cont)									
R266	100	MF		38570	R323	2k2	CF		21802
R267	100	MF		38570	R324	47	CF	1/8W	43146
R268	510	MF		38587	R325	47	CF	1/8W	43146
R269	1k	CF		21799	R326	270	CF		28720
R270	27	CF		28711	R327	270	CF		28720
R271	330	CF		28721	R328	1k5	CF		21801
R272	12k	CF		21810	R379	not used			
R273	1k	CF		21799	R330	68	CF		28716
R274	10	CF		21793	R331	68	CF		28716
R275	not used				R332	18k	CF		21811
R276	3k9	CF		21804	R333		CF	A.O.T	
R277	3k9	CF		21804	R334		CF	A.O.T	
R278	1k	PCP		39233	R335	10	CF		21793
R279	20k	PCP		39235	R336	47	CF	1/8W	43146
R280	50k	PCP		39268	R337	47	CF	1/8W	43146
R281	200	PCP		39231	R338	100	CF	1/8W	43150
R282	50	PCP		39267	R339	100	CF	1/8W	43150
R283	100	PCP		39230	R340	10	CF		21793
R284	1k	PCP		39233	R341	200	PCP		39231
R285	not used				R342	430	MF		38585
R286	47	CF		28714	R343	430	MF		38585
R287	47	CF		28714	R344	220	CF		21796
R288	22	CF	1/8W	43142	R345	1k	CF		21799
R289	2k2	CF	1/8W	43357	R346	1k	CF		21799
R290	not used				R347	100	CF	1/8W	43150
R291	3k3	CF	1/8W	43358	R348	100	CF	1/8W	43150
R292	not used				R349	820	CF		28724
R293	1k2	CF		21800	R350	820	CF		28724
R294	47	CF		28714	R351	not used			
R295	47	CF		28714	R352	51	MF		38563
					R353	120	CF		28718
R298	33k	CF		21814	R354	47	CF	1/8W	43146
					R355	1k5	CF		21801
R301	47	CF		28714	R356	1k	PCP		39233
R302	47	CF		28714	R357	3k3	CF		21803
R303	33	CF		28712	R358	100k	CF		21819
R304	8k2	CF		21808	R359	1k	CF		21799
R305	100	CF	1/8W	43150	R360	10	CF		21793
R306	100	CF	1/8W	43150	R361	2k2	CF		21802
R307	560	CF		21798	R362	2k2	CF		21802
R308	150	CF		28719	R363	1k2	CF		21800
R309	150	CF		28719	R364	470	CF		21797
R310	47	CF		28714	R365	680	CF		28723
R311	47	CF		28714	R366	330	CF		28721
R312	22	CF	1/8W	43142	R367	1k	PCP		39233
R313	2k2	CF	1/8W	43357	R368	47	CF		28714
R314	220	CF		21796	R369	47	CF		28714
R315	3k3	CF	1/8W	43358	R370		Resistor Network 2.2k 8 way		43185
R316	620	MF		38589					
R317	620	MF		38589	R371		Resistor Network 2.2k 8 way		43185
R318	100	CF	1/8W	43150					
R319	100	CF	1/8W	43150	R372	47	CF		28714
R320	150	CF		28719	R373	47	CF		28714
R321	100	CF	1/8W	43150	R374	47	CF		28714
R322	3k9	CF		21804	R375	47	CF		28714

Component List and Illustrations

Section 6

OS3600 'Y' PRE-AMP BEAM SWITCH, 'Y' DRIVER & O/P (Cont)

Ref	Value	Description	Tol %±	Part No	Ref	Value	Description	Tol %±	Part No
RESISTORS (Cont)									
R376	1k	CF		21799	R432	220k	CF		21823
R377	2k2	CF		21802	R433	6M2	MG	½W	42132
R378	2k2	CF		21802	R434	560	CF		21798
R379	100	CF	1/8W	43150	R435	1k	CP	Scale Illum.	A4/38680
R380	100	CF	1/8W	43150	R436	2k2	CP	Trace Rotation	A4/38678
R381	10	CF		21793	R437	10k	CP	Intensity	A4/38681
R382	10k	PCP		39265	R438	1M	CP	Focus	A4/38679
R383	5k6	CF		21806	R439	100k	PCP		39269
R384	5k6	CF		21806	R440	1M	PCP		39431
R385	1k	CF		21799	R441	not used			
R386	2k2	CF		21802	R442	1k	CF		21799
R387	1k2	CF		21800	R443	not used			
R388	1k	CF		21799	R444	47	CF		28714
R389	1k	CF		21799					
R390	1k2	CF		21800	R447	39k	CF		28728
R391	1k2	CF		21800	R448	82k	CF		21818
R392	1k	CF		21799	R449	not used			
R393	1k	CF		21799	R450	10	CF		21793
R394	750	MF		38591	R451	10	CF		21793
R395	2k2	CF		21802	R452	1k5	CF		21801
R396	330	CF		28721	R453	47	CF		28714
R397	100	CF	1/8W	43150	R454	47	CF		28714
R398	100	CF	1/8W	43150	R455	68	CF		28716
R399	100	CF	1/8W	43150	R456	33	CF	A.O.T.	28712
					R457	10	CF		21793
R401	100	CF		21794					
R402	680	CF		28723	R471	10	CF		21793
R403	100	CF		21794	R472	10	CF		21793
R404	680	CF		28723	R473	510	MO	5 6W	40318
R405	100	CF		21794	R474	510	MO	5 6W	40318
R406	100	CF		21794	R475	10	CF		21793
R407	470	CF		21797	R476	47	CF	½W	18534
R408	820	CF		28724					
R409	560	CF		21798	R1341	100	CF		21794
R410	560	CF		21798	R1342	100	CF		21794
R411	330	CF		28721					
R412	270	CF		28720	R1351	47	CF		28714
R413	270	CF		28720	R1352	47	CF		28714
R414	180	CF		21795					
R415	82	CF		28717	R1356	47	CF		28714
R416	82	CF		28717	R1357	47	CF		28714
R417	560	CF		21798					
R418	560	CF		21798	R1362	100	CF	1/8W	43150
R419	not used				R1363	not used			
R420	22k	CF		21812	R1364	47	CF		28714
R421	3k3	CF		21803	R1365	47	CF		28714
R422	180	CF		21795	R1366	22	CF	1/8W	43142
R423	180	CF		21795	R1367	22	CF	1/8W	43142
R424	470	CF		21797	R1368	22	CF	1/8W	43142
R425	150	CF	A.O.T.	28719	R1369	390	CF	A.O.T.	28722
					R1370	1k	CF		21799
R428	150	CF		28719	R1371	110	CF		21796
R429	470	CF	½W	18546	R1372	3k3	CF		21803
R430	not used				R1373	820	CF		28724
R431	100	CF		21794	R1374	1k5	CF		21801

Component List and Illustrations

Section 6

OS3600 'Y' PRE-AMP BEAM SWITCH, 'Y' DRIVER & O/P (Cont)

Ref	Value	Description	Tol % ±	Part No	Ref	Value	Description	Tol % ±	Part No
RESISTORS (Cont)									
R1375	not used				C104	.01μF	CE(1)	250V	42569
R1376	5k6	CF		21806	C105	.01μF	CE(1)	250V	42569
R1377	5k6	CF		21806	C106	.01μF	CE(1)	250V	42569
R1378	5k6	CF		21806	C107	5.6pF	CE(2)	A.O.T.	22361
R1379	5k6	CF		21806	C108	.01μF	CE(1)	250V	42569
R1380	2k7	CF		28726	C109	.01μF	CE(1)	250V	42569
R1381	330	CF		28721					
R1382	100	CF	1/8W	43150	C110	.01μF	CE(1)	250V	42569
R1383	not used				C111	1pF	CE(3)		36594
R1384	100	CF	1/8W	43150	C112	.01μF	CE(1)	250V	42569
CAPACITORS									
C51	4700pF	CE(1)		22393	C113	5.6pF	CE(3)		36603
C52	4700pF	CE(1)		22393	C114	.01μF	CE(1)	250V	42569
C53	0.1μF	PE	400V	29495	C115	.01μF	CE(1)	250V	42569
C54	0.1μF	PE	400V	29495	C116	.01μF	CE(1)	250V	42569
C55	10pF	CE(2)		22364	C117	not used			
C56	10pF	CE(2)		22364	C118	.01μF	CE(1)	250V	42569
C57	27pF	CE(2)		22369	C119	not used			
C58	27pF	CE(2)		22369	C120	not used			
C59	8.2pF	CE(2)		22363	C121	.01μF	CE(1)	250V	42569
C60	8.2pF	CE(2)		22363	C122	not used			
C61	47pF	Button Mica		29918	C123	12pF	CE(3)		36607
C62	47pF	Button Mica		29918	C124	330pF	CE(2)	100V	43438
C63	330pF	Button Mica		31293	C125	4/27pF	FT		36273
C64	330pF	Button Mica		31293	C126	1pF	CE(3)		36594
C65	2/10pF	TRIMMER	A4/43123		C127	1pF	CE(3)		36594
C66	2/10pF	TRIMMER	A4/43123		C128	.01μF	CE(1)	250V	42569
C67	2/10pF	TRIMMER	A4/43123		C129	not used			
C68	2/10pF	TRIMMER	A4/43123		C130	.01μF	CE(1)	250V	42569
C69	2/10pF	TRIMMER	43183		C131	15pF	CE(2)		22366
C70	2/10pF	TRIMMER	43183		C132	220pF	CE(2)		22379
C71	2/10pF	TRIMMER	43183		C133	.01μF	CE(1)	250V	42569
C72	2/10pF	TRIMMER	43183		C134	.01μF	CE(1)	250V	42569
C73	2/10pF	TRIMMER	43183		C135	not used			
C74	2/10pF	TRIMMER	43183		C136	.01μF	CE(1)	250V	42569
C75	27pF	CE(2)		22369	C137	220pF	CE(2)		22379
C76	18pF	CE(2)		22367	C138	120pF	CE(2)		22377
C77	27pF	CE(2)		22369	C201	.01μF	CE(1)	250V	42569
C78	18pF	CE(2)		22367	C202	5.6pF	CE(2)		22361
C79	.01μF	CE(1)		22395	C203	22μF	E	25V	32181
C80	.01μF	CE(1)		22395	C204	.01μF	CE(1)	250V	42569
C81	5600pF	CE(1)		22394	C205	.01μF	CE(1)	250V	42569
C82	5600pF	CE(1)		22394	C206	.01μF	CE(1)	250V	42569
C83	15pF	CE(2)		22366	C207	5.6pF	CE(2)	A.O.T.	22361
C84	15pF	CE(2)		22366	C208	.01μF	CE(1)	250V	42569
					C209	.01μF	CE(1)	250V	42569
C87	2.7pF	CE(3)		36599	C210	.01μF	CE(1)	250V	42569
C88	2.7pF	CE(3)		36599	C211	1pF	CE(3)		36594
C89	12pF	CE(2)		22365	C212	.01μF	CE(1)	250V	42569
C90	12pF	CE(2)		22365	C213	5.6pF	CE(3)		36603
					C214	.01μF	CE(1)	250V	42569
C101	.01μF	CE(1)	250V	42569	C221	.01μF	CE(1)	250V	42569
C102	5.6pF	CE(2)		22361	C222	not used			
C103	22μF	E	25V	32181	C223	12pF	CE(3)		36607

Component List and Illustrations

Section 6

OS3600 'Y' PRE-AMP BEAM SWITCH, 'Y' DRIVER & O/P (Cont)

Ref	Value	Description	Tol %±	Part No	Ref	Value	Description	Tol %±	Part No
CAPACITORS (Cont)									
C224	330pF	CE(2)	100V	43438	C408	1.5/9pF	FT		36272
C225	4/27pF	FT		36273	C409	4/27pF	FT		36273
C226	1pF	CE(3)		36594	C410	not used			
C227	1pF	CE(3)		36599	C411	.01μF	CE(1)	250V	22395
C228	.01μF	CE(1)	250V	42569	C412	8.2pF	CE(1)		22363
C229	.01μF	CE(1)	250V	42569	C413	.01μF	CE(1)	250V	22395
C230	.01μF	CE(1)	250V	42569	C414	not used			
C231	15pF	CE(2)		22366	C415	.01μF	CE(1)	250V	22395
C232	220pF	CE(2)		22379	C416	.01μF	CE(1)	250V	22395
C233	.01μF	CE(1)	250V	42569	C417	33μF	E	16V	32173
C234	.01μF	CE(1)	250V	42569	C418	.01μF	CE(1)	250V	22395
C235	not used								
C236	.01μF	CE(1)	250V	42569	C471	.01μF	CE(1)	250V	22395
C237	220pF	CE(2)		22379	C472	.01μF	CE(1)	250V	22395
C238	120pF	CE(2)		22377	C473	.1μF	CE(1)	25V	36709
C301	.01μF	CE(1)	250V	42569	TRANSISTORS				
C302	.01μF	CE(1)	250	42569	TR101	AE37			A4/40414
C303	22μF	E	25V	32181	TR102	BF371			36275
C304	.01μF	CE(1)	250V	42569	TR103	MPS H10			40315
C305	22μF	E	25V	32181	TR104	BF479			39270
C306	.047μF	CE(1)	10V	19657	TR105	BF479			39270
C307	.047μF	CE(1)	10V	19657	TR106	BC212			29327
C308	.047μF	CE(1)	10V	19657	TR107	BC182B			33205
C309	.047μF	CE(1)	10V	19657	TR108	BC212			29327
C310	270pF	CE(2)		22380	TR109	BC212			29327
C311	not used				TR110	MPS H10			40315
C312	560pF	CE(2)		22384	TR111	MPS H10			40315
C313	1.5/9pF	FT		36272	TR112	BC182B			33205
C314	not used								
C315	270pF	CE(2)		22380	TR201	AE37			A4/40414
C316	.01μF	CE(2)	250V	42569	TR202	BF371			36275
C319	.047μF	CE(1)	10V	19657	TR203	MPS H10			40315
C320	.047μF	CE(1)	10V	19657	TR204	BF479			39270
C321	22μF	E	25V	32181	TR205	BF479			39270
C322	5.6pF	CE(2)		22361	TR210	MPS H10			40315
C323	12pF	CE(3)	50V	36607	TR211	MPS H10			40315
C324	330pF	CE(2)	100V	43438	TR212	BC182B			33205
C325	4/27pF	FT		36273					
C326	2.2pF	CE(3)		36598	TR303	BF479			39270
C327	2.2pF	CE(3)		36598	TR304	BF479			39270
C328	2.2pF	CE(3)		36598	TR305	BF479			39270
C329	2.2pF	CE(3)		36598	TR306	BF479			39270
C330	2.2pF	CE(3)		36598	TR307	BC212			29327
C331	2.2pF	CE(3)		36598	TR308	BC182B			33205
C332	5.6pF	CE(2)		22361	TR309	2N5771			38089
C401	560pF	CE(2)		22384	TR310	MPS 2369			36625
C402	560pF	CE(2)		22384	TR311	2N5771			38089
C403	560pF	CE(2)		22384	TR312	ZTX326A			41753
C404	560pF	CE(2)		22384					
C405	8.2pF	CE(2)		22363	TR401	BF479			39270
C406	18pF	CE(2)		22367	TR402	BF479			39270
C407	18pF	CE(2)		22367	TR403	ZTX326A			41753
					TR404	ZTX326A			41753

Component List and Illustrations

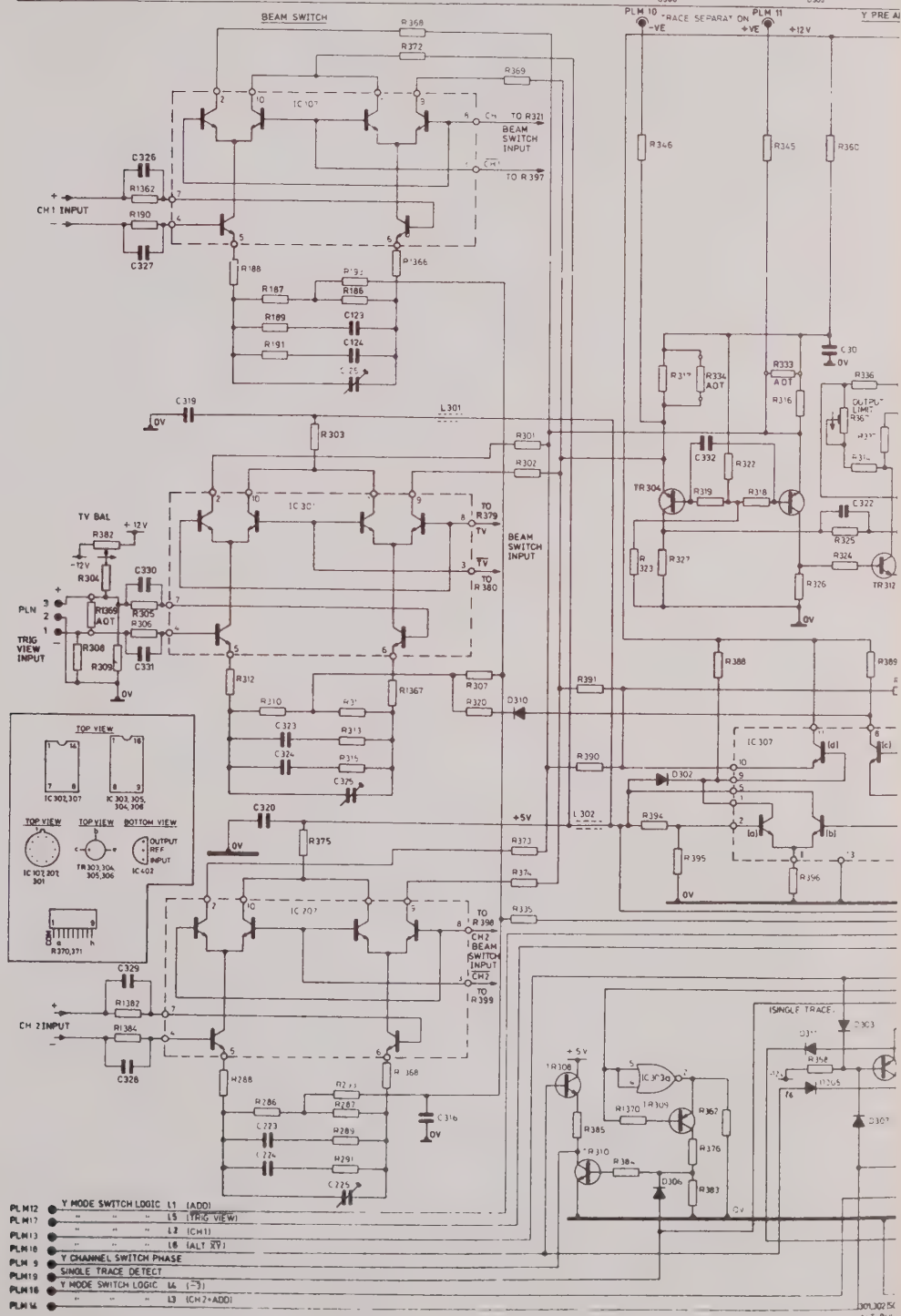
Section 6

OS3600 'Y' PRE-AMP BEAM SWITCH, 'Y' DRIVER & O/P (Cont)

Ref	Value	Description	Tol % ±	Part No	Ref	Value	Description	Tol % ±	Part No
TRANSISTORS (Cont)									
TR405		BFY51		29329	IC301		SL2363C		42631
TR406		BFX88		23337	IC302		SL3145		40784
DIODES									
D101	3V3	ZENER		33923	IC303		MC10102		39243
D102		IN3595		29330	IC304		MC10102		39243
D103	3V3	ZENER		33923	IC305		MC10103		40346
D104		IN3595		29330	IC306		MC10135		42128
D105	8V2	ZENER		33933	IC307		CA 3086		42907
D106	3V3	ZENER		33923	IC402		78LO5		40406
D107		IN3595		29330	IC471		OM504		42124
D108	4V7	ZENER		33927	MISCELLANEOUS				
D109	4V7	ZENER		33927	L101		Ferrite Bead FX1242		26986
D110	2V7	ZENER		33921	L102		Ferrite Bead FX1242		26986
D201	3V3	ZENER		33923	L201		Ferrite Bead FX1242		26986
D202		IN3595		29330	L202		Ferrite Bead FX1242		26986
D203	3V3	ZENER		33923	L301		Ferrite Bead FX1242		26986
D204		IN3595		29330	L302		Ferrite Bead FX1242		26986
D205	8V2	ZENER		33933	L471	0.47μH	Choke		43128
D206	3V3	ZENER		33923	L472	0.47μH	Choke		43128
D207		IN3595		29330	T101		Balancing Transformer		A4/43216
D301	6V2	ZENER		33930	T102		Balancing Transformer		A4/43216
D302		IN4148		23802	S7		CH1 Uncal		
D303		IN4148		23802			Part of R13		A4/42993
D304		IN4148		23802	S8		CH2 Uncal		
D305		IN4148		23802			Part of R14		A4/42993
D306		IN4148		23802	S9		Attenuator CH1		42135
D307		IN4148		23802	S10		Attenuator CH2		42136
D308		IN4148		23802	S11/12		AC/DC/GND CH1		A3/40734
D309		IN4148		23802	S13/14		AC/DC/GND CH2		A3/40734
D310		IN4148		23802	S101		Invert CH1		A3/40742
D311		IN4148		23802	S201		Invert CH2		A3/40742
D401		IN4148		23802	S400		Trace Locate		A3/40741
D402	9V1	ZENER		33934	PLG		Molex 2-Way		41391
D403		IN4148		23802	PLH		Molex 4-Way		41393
D404		IN4148		23802	PLJ		Molex 2-Way		41391
INTEGRATED CIRCUITS									
IC101		LF355BN		42050	PLK		Molex 3-Way		54181
IC102		SL360C		42126	PLL		Molex 12-Way		37879
IC103		SL2363C	Selected	42630	PLM		Molex 19-Way		42502
IC104		SL3145		40784	PLN		Molex 3-Way		41395
IC105		SL3145		40784	SKAA		Socket BNC 50Ω		1222
IC106		4066B		40044	SKBB		Socket BNC 50Ω		1222
IC107		SL2363C		42631	PLNN		Molex 3-Way		37881
IC201		LF355BN		42050	PLPP		Molex 3-Way		37881
IC202		SL360C		42126					
IC203		SL2363C	Selected	42630					
IC204		SL3145		40784					
IC205		SL3145		40784					
IC207		SL2363C		42631					

RESIS	R103 R108 R208	R91 R209	R53 R52	R47 R48	R43 R44	R6 R61	R63 R64	R57 R58	R55 R56	R45 R46	R79 R80	R81 R82	R83 R84	R106 R107	R179 R207	R111 R112 R113 R114 R115 R116 R117	R118 R119 R120 R121 R122 R123 R124 R125	R126 R127	R128 R129	R130 R131	R132 R133	R134 R135	R136 R137	R138 R139	R140 R141	R142 R143	R144 R145	R146 R147	R148 R149	R150 R151	R152 R153	R154 R155	R156 R157	R158 R159	R160 R161	R162 R163	R164 R165	R166 R167	R168 R169	R170 R171	R172 R173	R174 R175	R176 R177	R178 R179	R180 R181	R182 R183	R184 R185	R186 R187	R188 R189	R190 R191	R192 R193	R194 R195	R196 R197	R198 R199	R200 R201	R202 R203	R204 R205	R206 R207	R208 R209	R210 R211	R212 R213	R214 R215	R216 R217	R218 R219	R220 R221	R222 R223	R224 R225	R226 R227	R228 R229	R230 R231	R232 R233	R234 R235	R236 R237	R238 R239	R240 R241	R242 R243	R244 R245	R246 R247	R248 R249	R250 R251	R252 R253	R254 R255	R256 R257	R258 R259	R260 R261	R262 R263	R264 R265	R266 R267	R268 R269	R270 R271	R272 R273	R274 R275	R276 R277	R278 R279	R280 R281	R282 R283	R284 R285	R286 R287	R288 R289	R290 R291	R292 R293	R294 R295	R296 R297	R298 R299	R300 R301	R302 R303	R304 R305	R306 R307	R308 R309	R310 R311	R312 R313	R314 R315	R316 R317	R318 R319	R320 R321	R322 R323	R324 R325	R326 R327	R328 R329	R330 R331	R332 R333	R334 R335	R336 R337	R338 R339	R340 R341	R342 R343	R344 R345	R346 R347	R348 R349	R350 R351	R352 R353	R354 R355	R356 R357	R358 R359	R360 R361	R362 R363	R364 R365	R366 R367	R368 R369	R370 R371	R372 R373	R374 R375	R376 R377	R378 R379	R380 R381	R382 R383	R384 R385	R386 R387	R388 R389	R390 R391	R392 R393	R394 R395	R396 R397	R398 R399	R400 R401	R402 R403	R404 R405	R406 R407	R408 R409	R410 R411	R412 R413	R414 R415	R416 R417	R418 R419	R420 R421	R422 R423	R424 R425	R426 R427	R428 R429	R430 R431	R432 R433	R434 R435	R436 R437	R438 R439	R440 R441	R442 R443	R444 R445	R446 R447	R448 R449	R450 R451	R452 R453	R454 R455	R456 R457	R458 R459	R460 R461	R462 R463	R464 R465	R466 R467	R468 R469	R470 R471	R472 R473	R474 R475	R476 R477	R478 R479	R480 R481	R482 R483	R484 R485	R486 R487	R488 R489	R490 R491	R492 R493	R494 R495	R496 R497	R498 R499	R500 R501	R502 R503	R504 R505	R506 R507	R508 R509	R510 R511	R512 R513	R514 R515	R516 R517	R518 R519	R520 R521	R522 R523	R524 R525	R526 R527	R528 R529	R530 R531	R532 R533	R534 R535	R536 R537	R538 R539	R540 R541	R542 R543	R544 R545	R546 R547	R548 R549	R550 R551	R552 R553	R554 R555	R556 R557	R558 R559	R560 R561	R562 R563	R564 R565	R566 R567	R568 R569	R570 R571	R572 R573	R574 R575	R576 R577	R578 R579	R580 R581	R582 R583	R584 R585	R586 R587	R588 R589	R590 R591	R592 R593	R594 R595	R596 R597	R598 R599	R600 R601	R602 R603	R604 R605	R606 R607	R608 R609	R610 R611	R612 R613	R614 R615	R616 R617	R618 R619	R620 R621	R622 R623	R624 R625	R626 R627	R628 R629	R630 R631	R632 R633	R634 R635	R636 R637	R638 R639	R640 R641	R642 R643	R644 R645	R646 R647	R648 R649	R650 R651	R652 R653	R654 R655	R656 R657	R658 R659	R660 R661	R662 R663	R664 R665	R666 R667	R668 R669	R670 R671	R672 R673	R674 R675	R676 R677	R678 R679	R680 R681	R682 R683	R684 R685	R686 R687	R688 R689	R690 R691	R692 R693	R694 R695	R696 R697	R698 R699	R699 R700	R701 R702	R703 R704	R705 R706	R707 R708	R709 R710	R711 R712	R713 R714	R715 R716	R717 R718	R719 R720	R721 R722	R723 R724	R725 R726	R727 R728	R729 R730	R731 R732	R733 R734	R735 R736	R737 R738	R739 R740	R741 R742	R743 R744	R745 R746	R747 R748	R749 R750	R751 R752	R753 R754	R755 R756	R757 R758	R759 R760	R761 R762	R763 R764	R765 R766	R767 R768	R769 R770	R771 R772	R773 R774	R775 R776	R777 R778	R779 R780	R781 R782	R783 R784	R785 R786	R787 R788	R789 R790	R791 R792	R793 R794	R795 R796	R797 R798	R799 R800	R801 R802	R803 R804	R805 R806	R807 R808	R809 R810	R811 R812	R813 R814	R815 R816	R817 R818	R819 R820	R821 R822	R823 R824	R825 R826	R827 R828	R829 R830	R831 R832	R833 R834	R835 R836	R837 R838	R839 R840	R841 R842	R843 R844	R845 R846	R847 R848	R849 R850	R851 R852	R853 R854	R855 R856	R857 R858	R859 R860	R861 R862	R863 R864	R865 R866	R867 R868	R869 R870	R871 R872	R873 R874	R875 R876	R877 R878	R879 R880	R881 R882	R883 R884	R885 R886	R887 R888	R889 R890	R891 R892	R893 R894	R895 R896	R897 R898	R899 R900	R901 R902	R903 R904	R905 R906	R907 R908	R909 R910	R911 R912	R913 R914	R915 R916	R917 R918	R919 R920	R921 R922	R923 R924	R925 R926	R927 R928	R929 R930	R931 R932	R933 R934	R935 R936	R937 R938	R939 R940	R941 R942	R943 R944	R945 R946	R947 R948	R949 R950	R951 R952	R953 R954	R955 R956	R957 R958	R959 R960	R961 R962	R963 R964	R965 R966	R967 R968	R969 R970	R971 R972	R973 R974	R975 R976	R977 R978	R979 R980	R981 R982	R983 R984	R985 R986	R987 R988	R989 R990	R991 R992	R993 R994	R995 R996	R997 R998	R999 R1000	R1001 R1002	R1003 R1004	R1005 R1006	R1007 R1008	R1009 R1010	R1011 R1012	R1013 R1014	R1015 R1016	R1017 R1018	R1019 R1020	R1021 R1022	R1023 R1024	R1025 R1026	R1027 R1028	R1029 R1030	R1031 R1032	R1033 R1034	R1035 R1036	R1037 R1038	R1039 R1040	R1041 R1042	R1043 R1044	R1045 R1046	R1047 R1048	R1049 R1050	R1051 R1052	R1053 R1054	R1055 R1056	R1057 R1058	R1059 R1060	R1061 R1062	R1063 R1064	R1065 R1066	R1067 R1068	R1069 R1070	R1071 R1072	R1073 R1074	R1075 R1076	R1077 R1078	R1079 R1080	R1081 R1082	R1083 R1084	R1085 R1086	R1087 R1088	R1089 R1090	R1091 R1092	R1093 R1094	R1095 R1096	R1097 R1098	R1099 R1100	R1101 R1102	R1103 R1104	R1105 R1106	R1107 R1108	R1109 R1110	R1111 R1112	R1113 R1114	R1115 R1116	R1117 R1118	R1119 R1120	R1121 R1122	R1123 R1124	R1125 R1126	R1127 R1128	R1129 R1130	R1131 R1132	R1133 R1134	R1135 R1136	R1137 R1138	R1139 R1140	R1141 R1142	R1143 R1144	R1145 R1146	R1147 R1148	R1149 R1150	R1151 R1152	R1153 R1154	R1155 R1156	R1157 R1158	R1159 R1160	R1161 R1162	R1163 R1164	R1165 R1166	R1167 R1168	R1169 R1170	R1171 R1172	R1173 R1174	R1175 R1176	R1177 R1178	R1179 R1180	R1181 R1182	R1183 R1184	R1185 R1186	R1187 R1188	R1189 R1190	R1191 R1192	R1193 R1194	R1195 R1196	R1197 R1198	R1199 R1200	R1201 R1202	R1203 R1204	R1205 R1206	R1207 R1208	R1209 R1210	R1211 R1212	R1213 R1214	R1215 R1216	R1217 R1218	R1219 R1220	R1221 R1222	R1223 R1224	R1225 R1226	R1227 R1228	R1229 R1230	R1231 R1232	R1233 R1234	R1235 R1236	R1237 R1238	R1239 R1240	R1241 R1242	R1243 R1244	R1245 R1246	R1247 R1248	R1249 R1250	R1251 R1252	R1253 R1254	R1255 R1256	R1257 R1258	R1259 R1260	R1261 R1262	R1263 R1264	R1265 R1266	R1267 R1268	R1269 R1270	R1271 R1272	R1273 R1274	R1275 R1276	R1277 R1278	R1279 R1280	R1281 R1282	R1283 R1284	R1285 R1286	R1287 R1288	R1289 R1290	R1291 R1292	R1293 R1294	R1295 R1296	R1297 R1298	R1299 R1300	R1301 R1302	R1303 R1304	R1305 R1306	R1307 R1308	R1309 R1310	R1311 R1312	R1313 R1314	R1315 R1316	R1317 R1318	R1319 R1320	R1321 R1322	R1323 R1324	R1325 R1326	R1327 R1328	R1329 R1330	R1331 R1332	R1333 R1334	R1335 R1336	R1337 R1338	R1339 R1340	R1341 R1342	R1343 R1344	R1345 R1346	R1347 R1348	R1349 R1350	R1351 R1352	R1353 R1354	R1355 R1356	R1357 R1358	R1359 R1360	R1361 R1362	R1363 R1364	R1365 R1366	R1367 R1368	R1369 R1370	R1371 R1372	R1373 R1374	R1375 R1376	R1377 R1378	R1379 R1380	R1381 R1382	R1383 R1384	R1385 R1386	R1387 R1388	R1389 R1390	R1391 R1392	R1393 R1394	R1395 R1396	R1397 R1398	R1399 R1400	R1401 R1402	R1403 R1404	R1405 R1406	R1407 R1408	R1409 R1410	R1411 R1412	R1413 R1414	R1415 R1416	R1417 R1418	R1419 R1420	R1421 R1422	R1423 R1424	R1425 R1426	R1427 R1428	R1429 R1430	R1431 R1432	R1433 R1434	R1435 R1436	R1437 R1438	R1439 R1440	R1441 R1442	R1443 R1444	R1445 R1446	R1447 R1448	R1449 R1450	R1451 R1452	R1453 R1454	R1455 R1456	R1457 R1458	R1459 R1460	R1461 R1462	R1463 R1464	R1465 R1466	R1467 R1468	R1469 R1470	R1471 R1472	R1473 R1474	R1475 R1476	R1477 R1478	R1479 R1480	R1481 R1482	R1483 R1484	R1485 R1486	R1487 R1488	R1489 R1490	R1491 R1492	R1493 R1494	R1495 R1496	R1497 R1498	R1499 R1500	R1501 R1502	R1503 R1504	R1505 R1506	R1507 R1508	R1509 R1510	R1511 R1512	R1513 R1514	R1515 R1516	R1517 R1518	R1519 R1520	R1521 R1522	R1523 R1524	R1525 R1526	R1527 R1528	R1529 R1530	R1531 R1532	R1533 R1534	R1535 R1536	R1537 R1538	R1539 R1540	R1541 R1542	R1543 R1544	R1545 R1546	R1547 R1548	R1549 R1550	R1551 R1552	R1553 R1554	R1555 R1556	R1557 R1558	R1559 R1560	R1561 R1562	R1563 R1564	R1565 R1566	R1567 R1568	R1569 R1570	R1571 R1572	R1573 R1574	R1575 R1576	R1577 R1578	R1579 R1580	R1581 R1582	R1583 R1584	R1585 R1586	R1587 R1588	R1589 R1590	R1591 R1592	R1593 R1594	R1595 R1596	R1597 R1598	R1599 R1600	R1601 R1602	R1603 R1604	R1605 R1606	R1607 R1608	R1609 R1610	R1611 R1612	R1613 R1614	R1615 R1616	R1617 R1618	R1619 R1620	R1621 R1622	R1623 R1624	R1625 R1626	R1627 R1628	R1629 R1630	R1631 R1632	R1633 R1634	R1635 R1636	R1637 R1638	R1639 R1640	R1641 R1642	R1643 R1644	R1645 R1646	R1647 R1648	R1649 R1650	R1651 R1652	R1653 R1654	R1655 R1656	R1657 R1658	R1659 R1660	R1661 R1662	R1663 R1664	R1665 R1666	R1667 R1668	R1669 R1670	R1671 R1672	R1673 R1674	R1675 R1676	R1677 R1678	R1679 R1680	R1681 R1682	R1683 R1684	R1685 R1686	R1687 R1688	R1689 R1690	R1691 R1692	R1693 R1694	R1695 R1696	R1697 R1698	R1699 R1700	R1701 R1702	R1703 R1704	R1705 R1706	R1707 R1708	R1709 R1710	R1711 R1712	R1713 R1714	R1715 R1716	R1717 R1718	R1719 R1720	R1721 R1722	R1723 R1724	R1725 R1726	R1727 R1728	R1729 R1730	R1731 R1732	R1733 R1734	R1735 R1736	R1737 R1738	R1739 R1740	R174
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	R1362 R190	R188	R187 R189 R191	R303	R193 R196	R368 R372	R369	R301 R302	R346	R314 R319	R327 R318	R345 R332	R360 R336	R337 R311
RESIS	R308 R304 R305 R309 R1369	R305 R306 R1384	R310	R375 R376 R377	R371 R372 R373	R366 R374 R375	R307 R310	R373 R374 R375	R391 R390 R395	R311 R312 R313	R399 R398 R397	R345 R332 R316	R360 R336 R337	R311 R312 R313
CAP	C326 C327 C310 C319 C321 C318	C319 C320	C323 C324 C325	C323 C324 C325	C323 C324 C325	C316	C310	C310	C310	C310	C310	C310	C310	C310
MISC			IC107 IC101 IC201	IC107 IC101 IC201	IC107 IC101 IC201	L301	D310	TR308 TR310	TR308 TR310	TR308 TR310	TR308 TR310	IC107 IC101 IC201	TR308 TR310	TR308 TR310



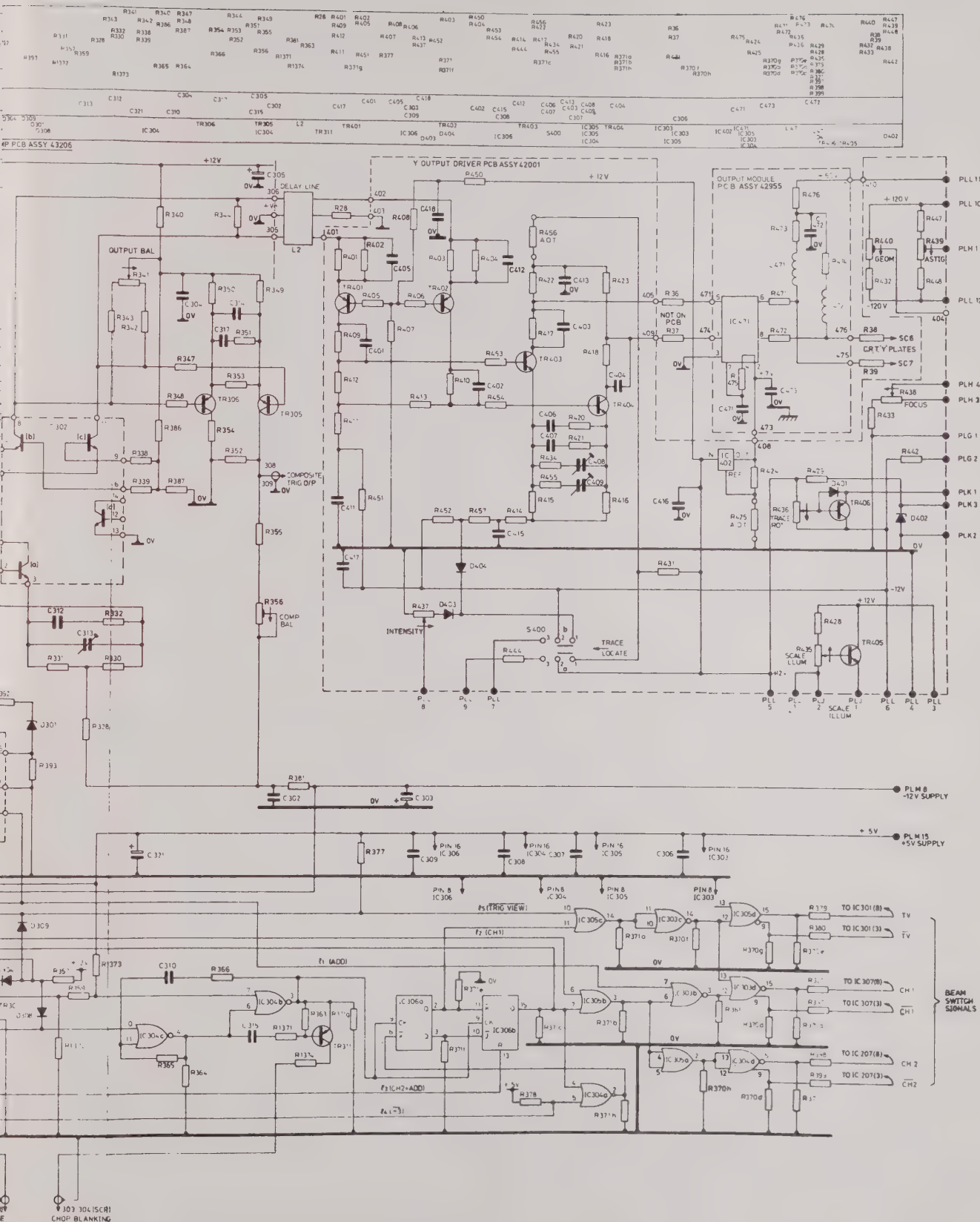


Fig. 9 'Y' Pre-amp Beam Switch, 'Y' Driver & O/P Circuit Diagram

Component List and Illustrations

Section 6

OS3500 POWER SUPPLY

Ref	Value	Description	Tol % ±	Part No	Ref	Value	Description	Tol % ±	Part No
RESISTORS					RESISTORS (Cont)				
R6	100k	CF		21819	R1036	33k	CF		21814
R428	150	CF		28719	R1037				
R429	470	CF	½W	18546	R1038				
R432	220k	CF		21823	R1039	1M	CF		31840
R433	6.2M	MG	5	42132	R1040				
R435	1k0	CP	Scale illumination	A4/38680	R1041	15	CF	1W	19026
R436	2k2	CP	Trace Rotate	A4/38678	R1042	2k7	MO		26728
R437	10k	CP	Intensity	A4/33681	R1043	200	MF		38577
R438	1M	CP	Focus	A4/38679	R1044	2k	MF		38601
R439	100k	PCP	Astigmatism	39269	R1045				
R440	1M	PCP	Geometry	39431	R1046				
R444	47	CF		28714	R1047	200	MF		38577
R447	39k	CF		28728	R1048	2k	MF		38601
R448	82k	CF		21818	R1049	243	MF	1	36628
R1001	2k2	CF		21802	R1050	750	MF	1	40369
R1002	39	CF		28713	R1051	100	PCP		39230
R1003	4k7	MF		38610	R1052	100	PCP		39230
R1004					R1053	1k5	CF		21801
R1005	1k2	MF		38596	R1054	5k6	MF		38612
R1006					R1055	47	CF		28714
R1007	10	CF		21793	R1056	18k	MF		38624
R1008	2k2	MF		38602	R1057	3k6	MF		38607
R1009	1k5	CF		21801	R1058	5k6	MF		21806
R1010					R1101	150	CF		28719
R1011	47	CF		28714	R1102	1k	CF		21799
R1012	18k	CF		21811	R1103	68k	CF		21816
R1013	5k6	CF		21806	R1104				
R1014	5k6	MF		38612	R1105	22k	CF		21812
R1015					R1106	50k	PCP		39268
R1016	39k	CF		28728	R1107				
R1017	100	CF		21794	R1108				
R1018	680	CF		28723	R1109	5k6	CF		21806
R1019	36k	MF		38631	R1110				
R1020					R1111	1k5	CF		21801
R1021	1k	CF		21799	R1112	220	CF		21796
R1022	33k	CF		21814	R1113	1k	CF		21799
R1023	68k	CF		21816	R1114	27k	CF		21813
R1024	33k	CF		21814	R1115				
R1025	6k8	MF		38614	R1116				
R1026	100	CF		21794	R1117	100	CF		21794
R1027	1k8	WW	2½W	17823	R1118	10k	CF		21809
R1028					R1119	1M	PCP		39431
R1029	6k8	MF		38614	R1120	10k	CF		21809
R1030					R1121	15M	MG		40371
R1031	4k7	MF		38610	R1122				
R1032	3k3	CF		21803	R1123	10k	CF		21809
R1033	10	CF		21793	R1124	2M7	MG		42133
R1034					R1125	22M	MG		40787
R1035	33k	CF		21814	R1126	27k	CF		21813
					CAPACITORS				
					C1	1000µF	E	100V	A4/40765
					C2	6800µF	E	25V	A4/40766
					C3	6800µF	E	25V	A4/40766

Component List and Illustrations

Section 6

OS3600 POWER SUPPLY (Cont)

Ref	Value	Description	Tol % ±	Part No	Ref	Value	Description	Tol % ±	Part No
CAPACITORS (Cont)					TRANSISTORS (Cont)				
C1001	10nF	CE(1)	250V	22395	TR1003		BC449		42131
C1002	10nF	CE(2)	250V	22395	TR1004		BC450		42130
C1003	68pF	CE(1)		22374	TR1005		2N5771		38089
C1004	10nF	CE(1)	250V	22395	TR1006		TIP30A		38415
C1005	10nF	CE(1)	250V	22395	TR1007		BC182B		33205
C1006	22μF	E	25V	32181					
C1007	10nF	CE(1)	250V	22395	TR1101		BC182B		33205
C1008	100nF	PE	100V	37018	TR1102		BC212		29327
C1009	22μF	E	25V	32181	TR1103		2SC1173		36188
C1010	100pF	CE(2)		22376	TR1104		BC212		29327
C1011	10nF	CE(1)	250V	22395	TR1105		BC449		42131
C1012	10nF	CE(1)	250V	22395					
C1013	10nF	CE(1)	500V	24902	INTEGRATED CIRCUITS				
C1014	4.7μF	CE(1)	4kV	40562	IC1001		LM317		40731
C1015	10nF	PE	5kV	37854	IC1002		LM317		40731
C1016	220μF	E	16V	42757	IC1003		LM317		40731
C1017	470μF	E	63V	40586	IC1004		μA723		31228
C1018									
C1019	220μF	E	100V	40587	DIODES				
					D1		IN4003		32771
C1021	220μF	E	100V	40587	D2		IN4003		32771
C1022	22μF	E	25V	32181	D3		IN4003		32771
C1023	22μF	E	25V	32181	D4		IN4003		32771
C1024					D5		IN4003		32771
C1025	6800μF	E	16V	A4/40559	D6		IN4003		32771
C1026	22μF	E	25V	32181	D7		IN4003		32771
C1027	4.7μF	T	25V	53249	D8		IN4003		32771
C1028	4.7μF	T	25V	53249	D9		IN4003		32771
C1029	10μF	E	250V	42137	D10		IN4003		32771
C1030	10μF	E	250V	42137					
C1031	10nF	CE(1)	250V	22395	D401		IN4148		23802
					D402	9V1	ZENER	5	400mW 33934
C1101	10nF	CE(1)	250V	22395					
C1102	22μF	E	25V	32181	D1001		IN4148		23802
C1103					D1002		FH1100		40352
C1104	100nF	PE	100V	37018	D1003		FH1100		40352
C1105	0.1μF	PE	250V	39199	D1004		FH1100		40352
C1106	220μF	E	16V	42757	D1005		IN4149		1949
C1107					D1006		IN4149		1949
C1108					D1007		IN4148		23802
C1109	470pF	CE(1)	4kV	43845	D1008	18V	ZENER	5	400mW 33941
C1110					D1009				
C1111	470pF	CE(1)	4kV	43845	D1010		IN4003		32771
C1112	10nF	CE(1)	250V	22395	D1011		IN4003		32771
C1113					D1012		IN4003		23462
C1114	4.7nF	CE(1)	4kV	40562	D1013		IN4148		23802
C1115	4.7nF	CE(1)	4kV	40562	D1014				
C1116	4.7nF	CE(1)	4kV	40562	D1015				
C1117	100nF	CE(1)	25V	36709	D1016	47V	ZENER	5	400mW 40049
					D1017		IN4003		32771
					D1018		IN4003		32771
TRANSISTORS					D1019				
TR405		BFY51		29329	D1020				
TR406		BFX88		23337	D1021		IN4003		32771
TR1001		MPS3640		24128	D1022		IN4003		32771
TR1002		2N5771		38089					

Component List and Illustrations

Section 6

OS3600 POWER SUPPLY (Cont)

Ref	Value	Description	Tol %±	Part No	Ref	Value	Description	Tol %±	Part No
DIODES (Cont)					MISCELLANEOUS (Cont)				
D1023		IN4003		32771	T1101		EHT Oscillator Trans- former		A2/41747
D1024									
D1025		IS923		3560					
D1026		IN4148		23802	S1		Power Switch		A4/36232
D1027		IN4148		23802					
D1028		IN4003		32771	S15		Switch Slider		
D1029		IN4003		32771			Supply Volts Selection		4069
D1030		IN4148		23802	S16		Switch Slider		
							Supply Volts Selection		4069
D1101		IN4148		23802					
D1102		IN4148		23802	S400		Switch Push Button		
D1103		IN4148		23802			Trace Locate		40741
D1104		IN4148		23802					
D1105		IN4148		23802					
D1106									
D1107		BY409		42356	FS1	500mA	Fuse 20mm Slo-Blo		33685
D1108		BY409		42356		1A	Fuse 20mm Slo-Blo		34790
D1109		IN4148		23802			115V Supply		
D1110					FS1001	500mA	Fuse 20mm Slo-Blo		33685
D1111		BY409		42356					
D1112		BY409		42356	PLA		Plug Molex 8 Way		43219
D1113					PLB		Plug Molex 9 Way		42633
D1114	150V	ZENER	1.3W	37559	PLC		Plug Molex 11 Way		40323
D1115		IN4148		23802	PLD		Plug Molex 8 Way		37877
					PLF		Plug Molex 9 Way		A2/42634
					PLJ		Plug Molex 2 Way		41391
					PLK		Plug Molex 3 Way		54181
					PLL		Plug Molex 12 Way		37879
					PLQ		Plug Molex 2 Way LKG		41391
MISCELLANEOUS					PLMM		IEC Supply Connector		33787
BR1001		WO2		19725					
BR1002		WO2		19725					
L1		Rotation Coil	Part of V1		MPR1		EHT Multiplier		42452
L5		Ferrite Bead FX1242		26986	V1		CRT D14-300GH		
L6		Ferrite Bead FX1242		26986			Normal Version		42123
L7		Ferrite Bead FX1242		26986		or	D14-300GM		
L8		Ferrite Bead FX1242		26986			Long Persis- tence Version		42451
L1101	150μH			35826	SKGG		Socket 4mm	Z Mod	29492
					SKHH		Socket 4mm	0V	29492
T1		Supply Transformer		A1/41751					

Component List and Illustrations

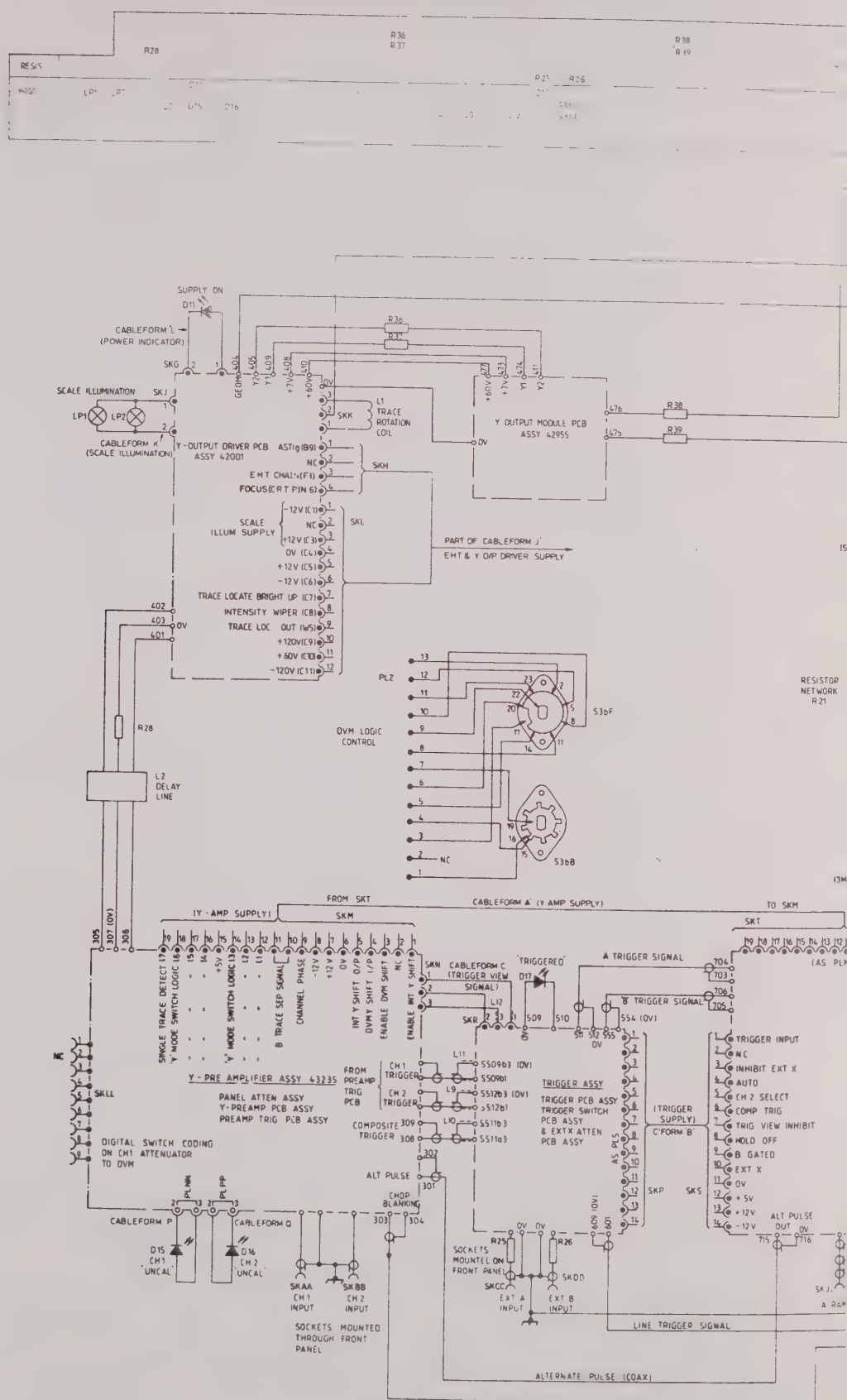
Section 6

OS3600 INTERCONNECTIONS

Ref	Value	Description	Tol % ±	Part No	Ref	Value	Description	Tol % ±	Part No
RESISTORS					SWITCHES (Cont)				
R2	10k	CP X Shift Coarse	}	A4/38689	S3		Switch "A" T/Base Range		38686
R3	10k	CP X Shift Fine			S4		Switch "B" " "		38687
R4	10k	CP Trace Sep.		A4/38673	S5		Switch "A" Uncal		
R5	5k	CP Delay		A4/38635			Part of R7		A4/38675
R6	100k	CF		21819	S6		Switch "B" Uncal		
R7	10k	CP A Var Vel		A4/38675			Part of R8		A4/38675
R8	10k	CP B Var Vel		A4/38675	DIODES				
R9	2k2	CF		21802	D11		L.E.D.		39884
R10	2k2	CF		21802	D12		L.E.D.		39884
R11	4k7			A4/42203	D13		L.E.D.		39884
R12	4k7			A4/42203	D14		L.E.D.		39884
					D15		L.E.D.		39884
R15	1k1	MF	0.5	41784	D16		L.E.D.		39884
					D17		L.E.D.		39884
R21		Resistor Network		A3/40102	LAMPS				
R22		Resistor Network		A3/40103	LP1	12V	Lamp		40328
R25	22	CF		28710	LP2	12V	Lamp		40328
R26	22	CF		28710	MISCELLANEOUS				
R28	100	CF		21794	V ₁		CRT D14-300 GH		
R36	10	CF		21793			Normal Version		42123
R37	10	CF		21793		OR	D14 300 GM		
R38	47	CF		28714			Long Persis- tance Version		42451
R39	47	CF		28714	MPR1		EHT Multiplier		42452
CAPACITORS					PLZ		Plug Molex 13 Way		39387
C79	0.01μF	CE(1)	250V	22395	PLMM		IEC Supply Connector		33787
C80	0.01μF	CE(1)	250V	22395	SKAA		Socket BNC		
							Y ₁ Input		1222
L1		Rotation Coil			SKBB		Socket BNC		
		Part of V1		—			Y ₂ Input		1222
L2		Delay Line		42647	SKCC		Socket BNC		
							Ext X "A" Input		1222
L5		Ferrite Bead FX1242		26986	SKDD		Socket BNC		
L6		Ferrite Bead FX1242		26986			Ext X "B" Input		1222
L7		Ferrite Bead FX1242		26986	SKEE		Terminal Feedthru		
L8		Ferrite Bead FX1242		26986			Cal Signal		31229
L9		Ferrite Ring			SKFF		Terminal 4mm		
		Part of Coax Cable					Earth		A3/40833
		P/No 43415			SKGG		Socket 4mm		
L10		Ferrite Ring					Z Mod		29492
		Part of Coax Cable			SKHH		Socket 4mm		
		P/No 43413					0V		29492
L11		Ferrite Ring			SKJJ		Socket BNC		
		Part of Coax Cable					"A" Ramp O/P		1222
		P/No 43414			SKKK		Socket BNC		
L12		Ferrite Ring					"B" Ramp O/P		1222
		Part of C/Form Cable			CABLEFORMS				
		P/No A3/43660			C/FORM				
SWITCHES					A		Y Amp Supply		A3/42385
S2		Switch PULL X10			B		Trigger Amp Supply		A3/42644
		Part of R2 + R3		A4/38689					

OS3600 INTERCONNECTIONS (Cont)

<i>Ref</i>	<i>Value</i>	<i>Description</i>	<i>Tol % ±</i>	<i>Part No</i>	<i>Ref</i>	<i>Value</i>	<i>Description</i>	<i>Tol % ±</i>	<i>Part No</i>
CABLEFORMS (Cont)									
C		Trigger View Signal		A3/43660	J		EHT & Y Output		
D		Timebase Supply		A3/42387			Driver Supply		A2/42388
E		A Timebase Controls		A3/41799	K		Scale Illumination		A3/41804
F		B Timebase Controls		A3/41800	L		Power Indicator		A4/41805
G		DVM Shorting Socket			M		C.R.T. Supply		A3/42386
		Use where No DIM		A4/41801	P		Y ₁ Uncal LED		A3/43659
		Fitted			Q		Y ₂ Uncal LED		A3/43659



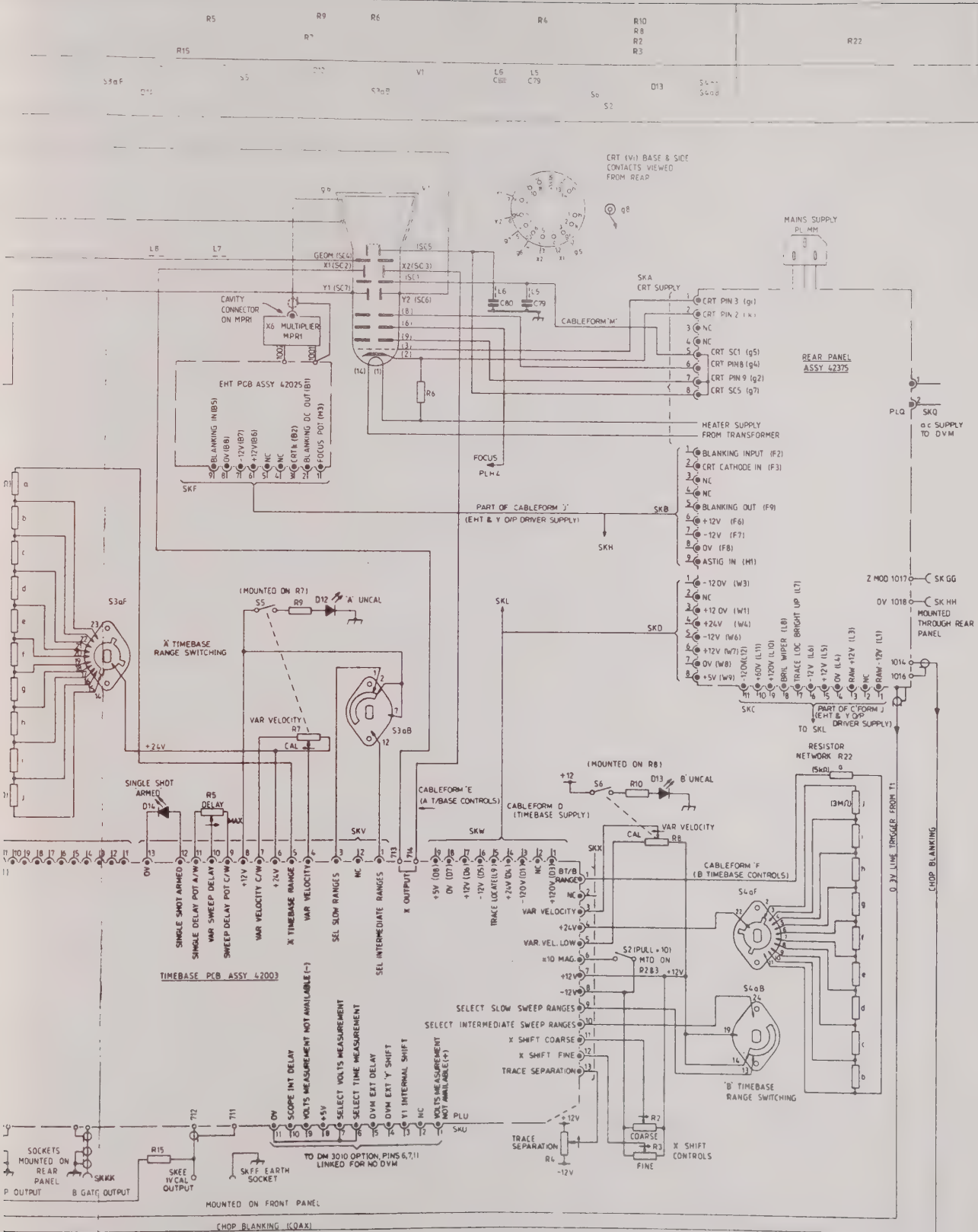


Fig. 11 Interconnections Circuit Diagram

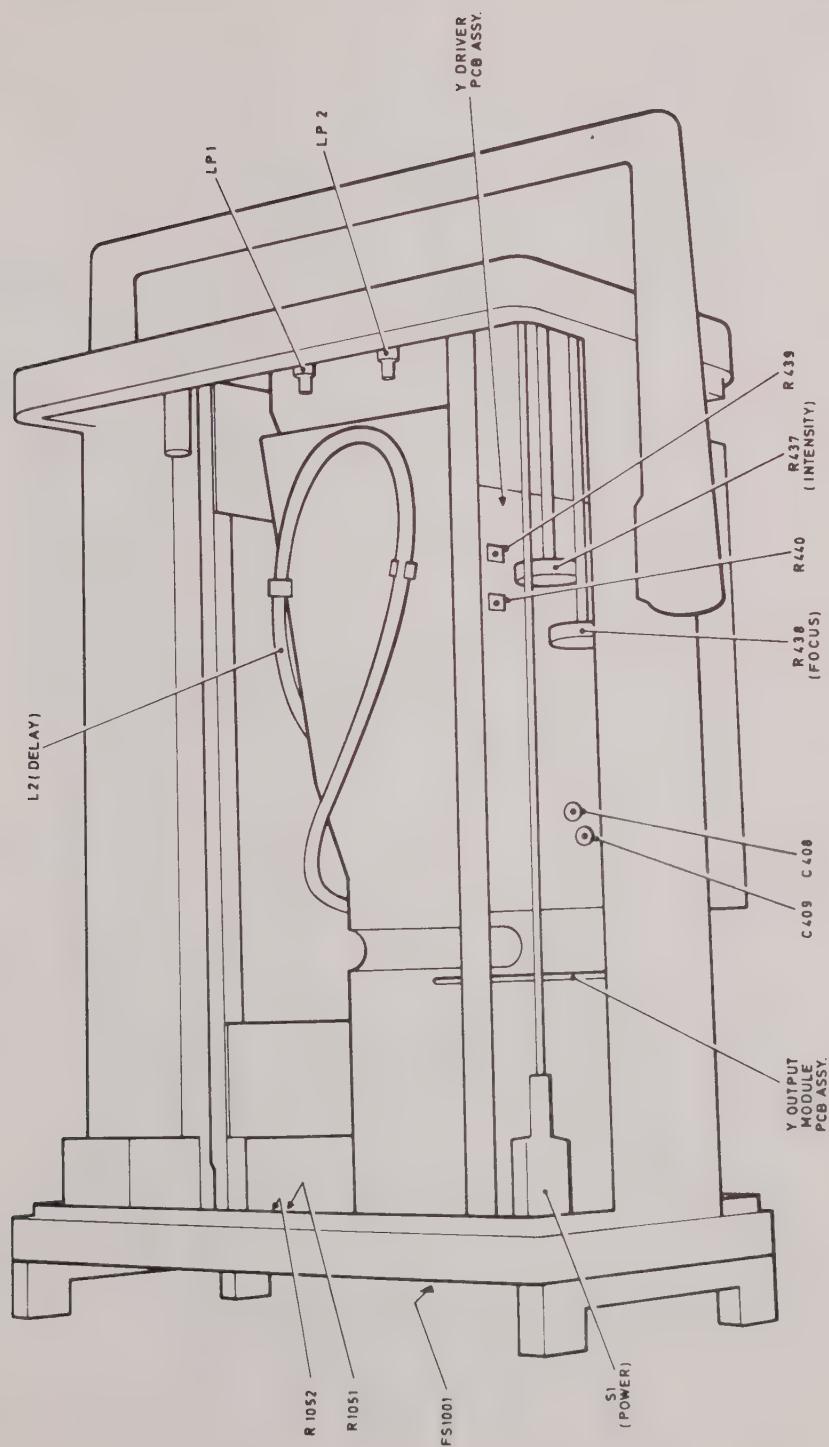


Fig. 12 Component Location Top Left View

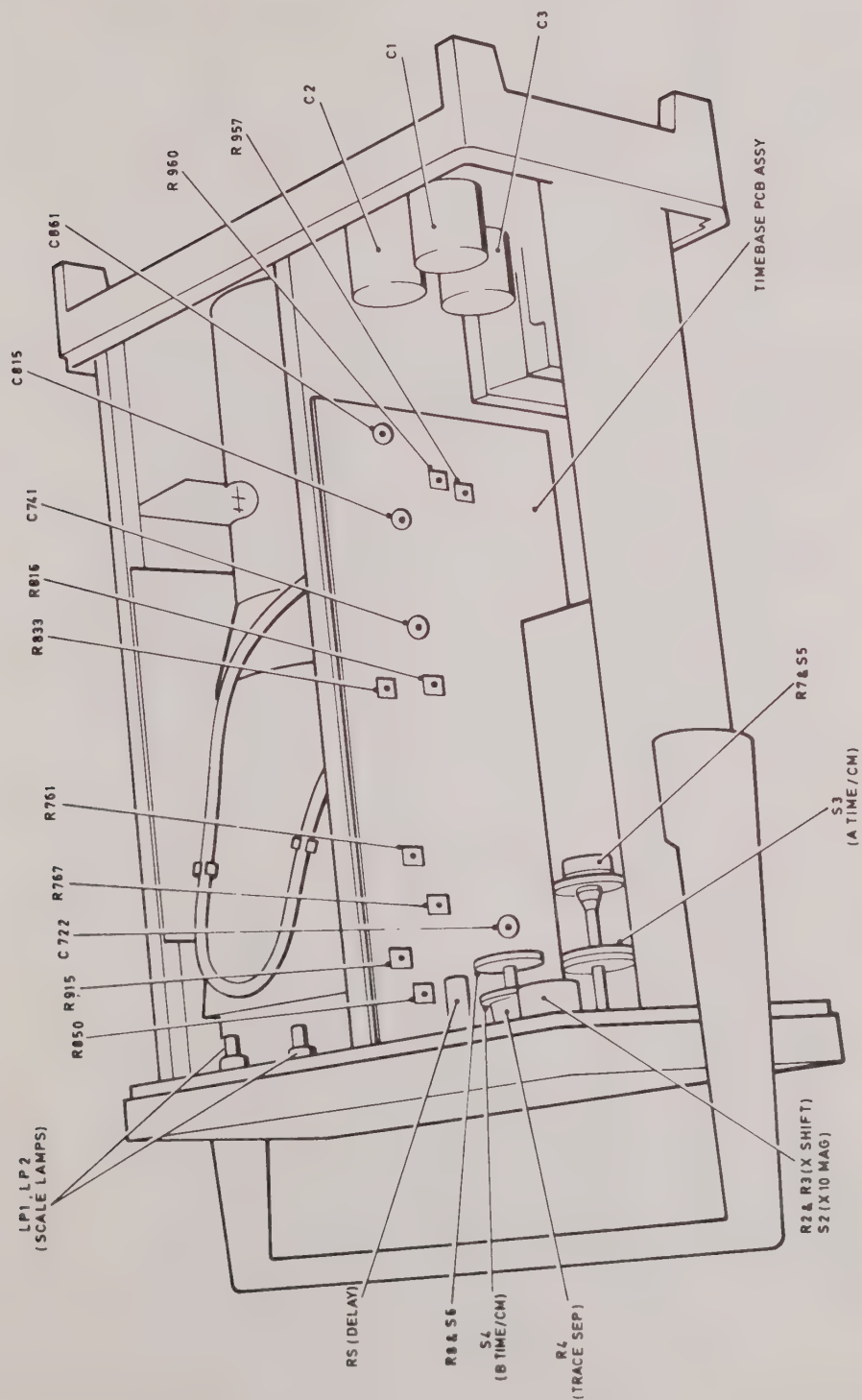


Fig. 13 Component Location Top Right View

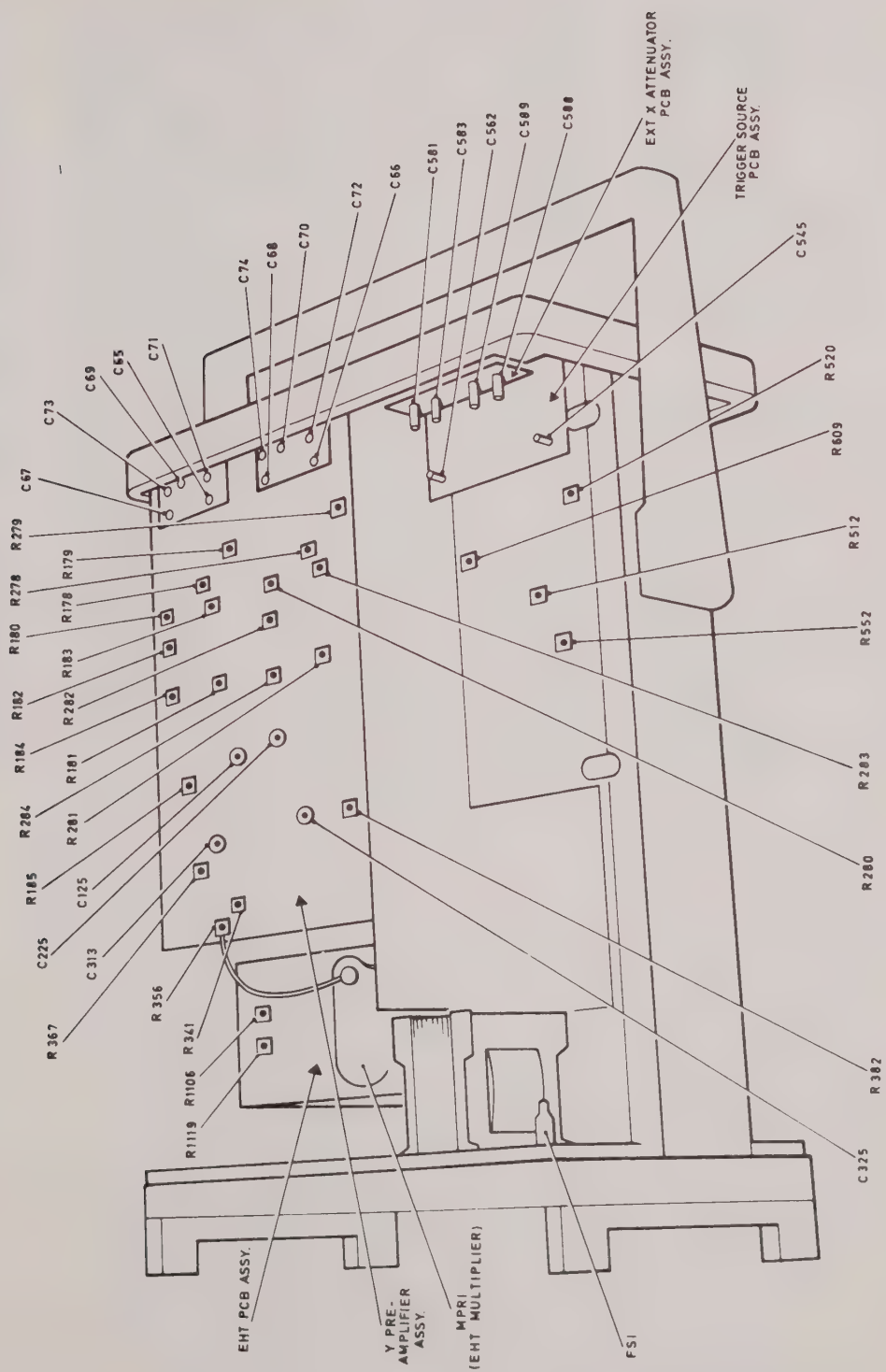
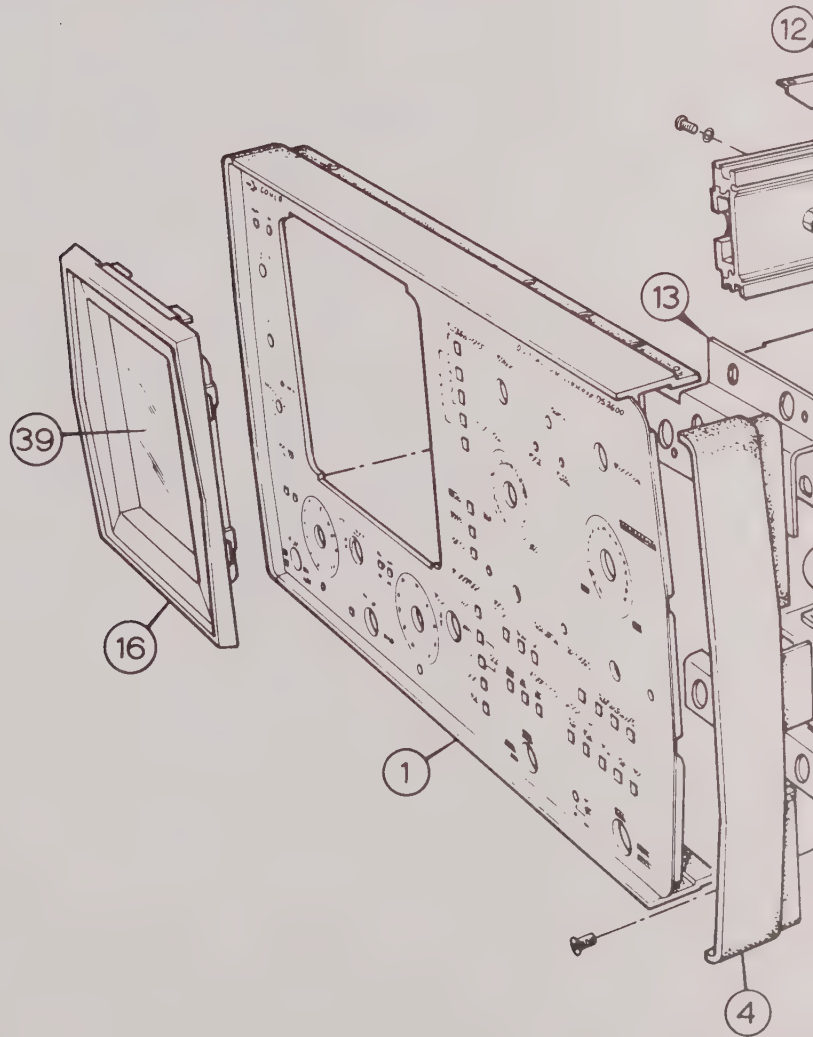
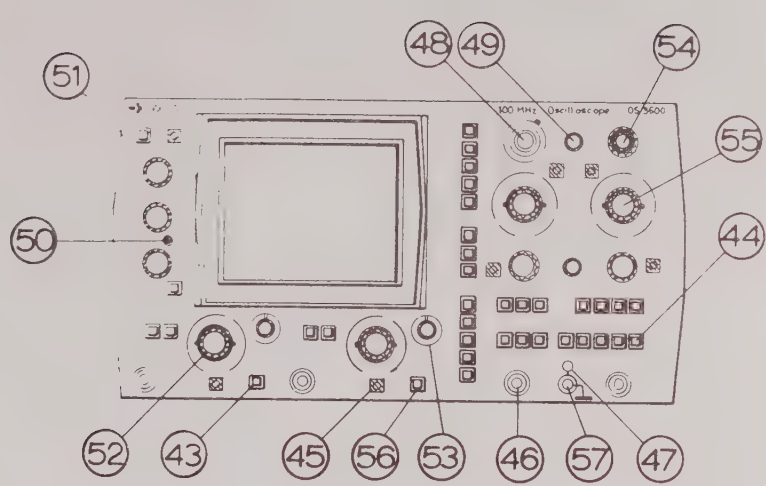


Fig. 14 Component Location Bottom View

Component List and Illustrations

Section 6

<i>Item No.</i>	<i>Pt. No.</i>	<i>Description</i>	<i>Qty.</i>	<i>Item No.</i>	<i>Pt. No.</i>	<i>Description</i>	<i>Qty.</i>
1	42282	Panel Front Composite	1	31	39097	Block Indexing	2
2	40674	Panel Rear	1	32	40677	Spacer to Bracket Assy.	2
3	42898	Side Support Bar	2	33	40676	Spacer to Bracket Assy.	2
4	39096	Corner Frame	4	34	29206	Spring	2
5	40809	Bracket Support E.H.T. C.R.T.	1	35	32626	Circlip	2
6	39101	Foot-Rear Support Moulding	2	36	40726	M3 Spacer	4
7	43757	Handle Assy.	1	37	38006	Fuse Holder	1
8	43208	Panel Attenuator	1	38	33685	Fuse Pt. No. 33685 500mA	2
9	42382	Heatsink	1		34790	Pt. No. 34790 1A	
10	42384	Mounting Bracket	1	39	40814	Filter Blue (Pt. No. 41381	
11	40829	Bracket P.C.B. Support	1			Filter Amber)	1
12	42355	Bracket P.C.B. Support	1	40	41764	M4 x 10 Hex. Hd. St. Cad.	
13	40806	Bracket Pot. Mounting	1			Plate	2
14	43202	Bracket (Etx. X Atten. P.C.B.)	1	41			
15	43209	Screen Attenuator	2	42			
16	39100	Bezel Mounting	1	43	40836	Knob P/B Light Brown	11
17	41822	Screen (Timebase/C.R.T.)	1	44	38407	Knob P/B Dark Brown	25
18	43074	Support Plate Front	1	45	39884	L.E.D.	7
19	43075	Support Plate Rear	1	46	1222	B.N.C. Socket	6
20	39916	Trim Side Rear	2	47	31229	Insert Feed Through	1
21	39915	Trim Side Front	2	48	36851	Dial Counting Knob	1
22	40844	Cover Rear	1	49	40408	Knob R2-234	4
23	40813	Cover Bottom	1	50	49635	M4 Ø Bush	2
24	40812	Cover Top	1	51	40923	Knob R2-354	5
25	41002	Screen (Trigger)	1	52	40410	Knob (Wing) R4-454	4
26	40808	Screen E.H.T.	1	53	41812	Nut Cover D/P W7-219	2
27	42876	Transformer Shield	1	54	40925	Knob R2-124	1
28	40641	Foot Bottom Cover	4	55	40922	Knob R2-324	4
29	37864	Latch	8	56	43256	Bezel - Pushbutton	36
30	37915	'O' Ring	8	57	40833	Terminal 4mm Earth	1



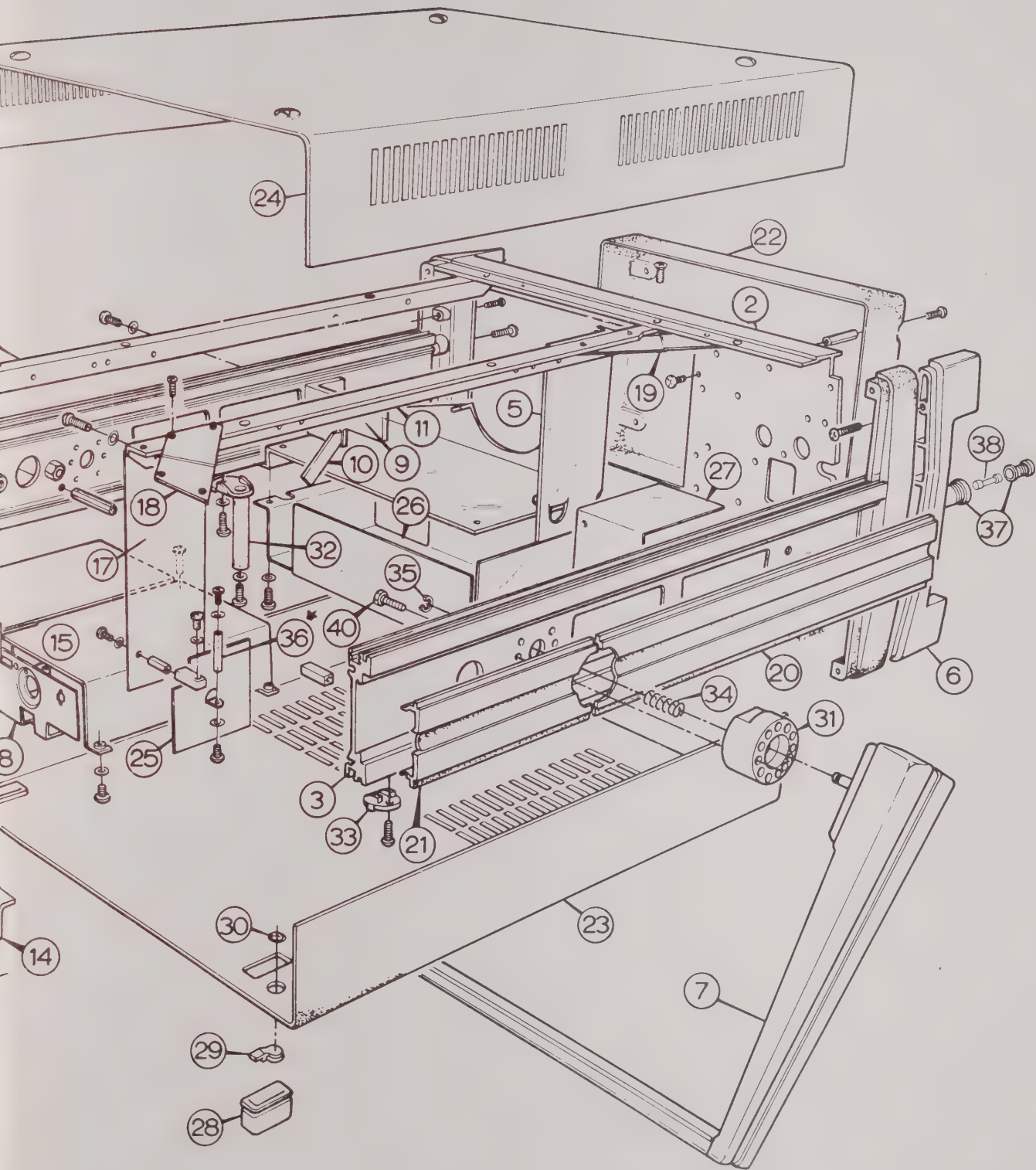


Fig. 15 Mechanical Assembly

WARRANTY AND SERVICE FACILITIES

Gould Oscilloscopes are warranted for a period of two years from date of shipment to original purchaser. They are warranted to conform to the applicable published specifications in effect at the time of shipment, and to be free from any defects in material or workmanship.

LIABILITY OF THE GOULD INSTRUMENTS DIVISION UNDER SUCH WARRANTY IS LIMITED TO SERVICING OR REPLACING DURING THE WARRANTY PERIOD AT THEIR OPTION, ANY DEFECTIVE PARTS EXCEPT COVERS, PROBES OR FUSES AND DOES NOT INCLUDE CALIBRATION AND MINOR MAIN-

TENANCE AS OUTLINED IN OPERATING MANUALS. IN NO EVENT SHALL THE GOULD INSTRUMENTS DIVISION BE LIABLE FOR COLLATERAL OR CONSEQUENTIAL DAMAGES.

Units are to be returned transportation prepaid by the buyer. The Gould Instruments Division will have the right of final determination of the cause and existence of a defect under this warranty. This warranty shall not apply to any products which have been subjected to misuse, improper installation, repair, alteration, neglect, accident, inundation, fire or operation outside their published maximum ratings.

PACKING INFORMATION

If the unit is to be returned for service, it must be adequately packed as follows:

- a) Seal the unit in an oversize plastic bag.
- b) Pack the bagged unit into a heavy duty cardboard box. The box must have a minimum of 2 inches of cushioning on all six sides, so that the unit fits snugly.
- c) Any accessories or instruction manuals must be sealed into a separate plastic bag and packed with a minimum of 2 inches of cushioning between the instrument and the accessories.
- d) Before sealing the box with packing tape, ensure that an official packing note is inserted, giving full details of sender's name, address and telephone number, instrument type number and serial number, plus an indication of the reason for return, and/or fault conditions, if applicable.
- e) Properly label and address the outside of the box.
- f) Notify Gould in advance of shipment and ship prepaid by United Parcel Service or equivalent.

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IMPORTANT

Warranty is valid only if you register the serial numbers of your equipment with Gould Inc.

Use the attached card for this purpose.

3-9-81

Registration Will:

1. Insure full protection under warranty conditions.
2. Prevent billing for repair work covered by warranty.

Model No. OS3600 Serial No. 566

Model No. DMM 3010 Serial No. 261

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